Universiteti i Sporteve të Tiranës

Fakulteti i Shkencave të Lëvizjes

DISSERTACION

MOTOR SKILLS AND COORDINATION ABILITIES IN ELEMENTARY SCHOOL CHILDREN IN TIRANA

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Abstract

The aim of this study is to monitor, motor skills and coordination in children inTirana city along one-year period. The study included a total of 148 children, randomlyselected from elementary schools in Tirana city. The tests used to find out healthparameters were: height, weight, BMI (kg/m2) and waist perimeter.

In order to evaluate coordination skills of upper body we have used the plate tappingtest (Eurofit 1993). In this monitoring study it was used the KTK battery (Kiphard andSchilling, 1974, 2007) to measure gross motor coordination. While, to assess the motorskills were used: standing long jump (to evaluate explosive power in lower limps), andsit and reach test for flexibility.

The Statistical analyses is performed via “IBM Statistics 22”. The statistical analysesincludes: descriptive analyses through statistical descriptive indicators, as well as theinferential analyses by comparing the mean of t-tests groups.

The statistical analysis for body weight showed an increase with 3.9 kg and bodyheight with 6 cm in children during one year, while the waist perimeter decreased with1cm between the first measurements at TI and the second at T2.

The comparison between the two measurements for the coordination skills of theupper limps (using plate tapping test) we could identify a significant difference betweenthe two measurements ($p < 0.05$). On the bases of these results we can conclude thatthere is a decrease of the coordination skills rom the first to the second measurementdone to the children, this is evident by the performance timing which increased by 1.77second.

The comparison of the dynamic balance at the two tests (T1 and T2) we found outa statistical difference between the two measurements ($p < 0.05$) with a difference with8.6 steps on the balance beam.

The results for the explosive power and coordination of lower limps, measured byjumping one leg test, showed an increase by 2.75 cm in the performance of power andcoordination of lower limps between the two measurements in T1 and T2.

The comparison between measurements in T1 and T2 on lateral jumping test showeda statistical significant difference ($p < 0.05$) with 9.3 jumps, while results from platemovement tests showed a difference with 6 movements between the measures taken atT1 and T2 ($p < 0.05$).

The results of standing long jump test, which was used to measure explosive power,identify an increase by 11 cm from T1 to T2.

In conclusion, we can say that there is an improvement of the explosive power inchildren. The results for flexibility test show that it has not improved between the twomeasurements done at T1 and T2, on the contrary flexibility has decreased by 1.03 cm.

The final results of the one-year monitoring of motor skills in children at elementaryschool give a clear picture of the progress of these skills along one academic year. Theresults indicate an improvement of the coordination skills in the bigger muscles, i.e.gross motor skills, as well as of the explosive power. It is not noticed any improvementof the fine motor skills in the upper limbs, on the contrary the results show a decreasein the measured values, and yet there is no improvement of flexibility. Moreover, it isnoticed a normal increase in weight, height and body mass index. The results yielded bythis monitoring study lead us to the conclusion that it is needed professional effort andexpertise by the PE teacher or specialist, thus the PE classes must be delivered by themand not teachers of other subjects.

The tests and measurements do not show an improvement of the motor skills whichmeans that it is needed a careful and more detailed preparation and planning of the PEclasses. In the children, who were subject of the study, it was noticed a developmentof the skills which are performed by activating the big muscles (gross motor skills)and these skills can be improved through active participation of the children in somegeneral games or activities.

Key world: coordination, motor abilities, flexibility, children, Tirana

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1-Introduction

In these last two decades, the studieshave shown that not only in developed countries, the number of obese children was increased *(Odgen CL et al., 2002).* While we can also see this phenomena is spreading among teenagers day after day *(Allison etal., 1991;Kavey et al., 2003).*

Given that the physical activity and fitness are closely related to body weight, these complex factors as low fitness and physical activity, affect the growth and diffusion of obesity in children. Until now we don`t have any study that has evidential about the body mass index in 6 -10 years old children, who practice physical activity, and develop coordination and motor ability but we can say that intervention in physical education classes may neutralize this phenomena *(AGA, 2004 ; Kavey et al., 2003)*.While in other studies about motor skills we have found out the obese children have shown lower value in motor skills, without taking in consideration gender *(D`hondt et al., 2009).* The general motor skills results are mixed due to lack of studies regarding obesity and motor skills in children up to 9 years old *(Dhonet et al., 2008)*. A normal coordination level is important for children growth not only for their health but for their academic achievements *(Vandorpe et al. 2011)*. For a better understanding, the perfection of motor abilities is required for a normal function *(Henderson&Sugden, 1992)*.

Consequently, more attention should be paid on motor abilities and coordination level especially in obese children, due to the fact that motor skills are dependent on obesity level *(Nunez-Gaunaurd et al., 2013).* Another interesting study of *(Lopes et al.,2012),* shows that obese boys and girls have lower physical and coordination motor skills comparing to their peers.

Purpose

The purpose of this study is to monitor, health parameters, coordinative and motor abilities in children of elementary school in Tirana during a period of one year.

Objectives

The objectives of this study are to measure coordinative and motor abilities in children during one year period, two times (T1 and T2) by monitoring health parameters.

• To perform measurement T1 (first measurement) for the health parameters; body weight, body height, BMI Body Mass Index (calculation in kg/m2) the measurement of the waist perimeter.

• To evaluate/measure the coordinative ability of the upper limbs in T1 (first measurement) through the plate tapping test.

• To evaluate/measurein T1 (first measurement) gross motor coordination, balance beam test, jumping one leg, lateral jumping and plate movement test.

• To evaluate/measure in T1 (first measurement) motor skills, long jumping test (explosive power of lower limps) and flexibility test (sit and reach).

• To monitor during one year period all the measurements, and to measure all this abilities in T2 (time 2).

Hypothesis

The hypothesis of this study are the motor abilities of children that must have a significant and statistical improvement during one year period especially in the coordination abilities, taking into consideration the age of children gives them a predisposition in profiting from these abilities .

2. Review of Literature

Many studies have shown that sedentary lifestyle is not only negative related to the body weight, but its impact is shown in the lower physical performance and also many children do not get involved in physical activities in their everyday life, and this puts their health at risk leading them to an inactive lifestyle. The same study showed that a sedentary lifestyle not only impacts negatively the body weight but also the physical performance *(Nunez-Gaunaurd et al., 2013).* Being obese or overweight is negative for body health and for motor ability and coordination skills *(Okely et al., 2004; Graf et al., 2004).*

Physical performance is closely related to sport activities and can be improved with specific program designed for physical education. Physical performance in children is seen to be depended on anthropometric and body mass index data. Lack of physical activity and the improvement of sedentary lifestyle are not related to lack of energy in children but with the decreasing of physical activity and motor performance, for this reason it is highly recommended a healthy lifestyle and physical activity in children and teenagers *(Weil &Amundson, 1994).*

Fine motor abilities , are activities that involve using hands and fingers, the abilities which makes functioning of fine muscles to create an precise movement of small muscles. These fine motor abilities are developed by specific model that continues and is predictable during the first years of growth, starting from birth to elementary school *(Exner,2001).*

The development of fine motor skills and performance it’s important during the school year, and this integration continues during life. During the preschool phase children start imitating handwriting actions, self dressing, self feeding and exploring toys.

In a study of *(Woodward &Swinth, 2002)*, was found that children whose hand didn't cooperate, leads children to an nervous behavior and tendency to resist physical and coordination activity of finger and hand muscles.

Weakness in the fine motor skill are noticed mainly in the age before starting to write*(Dennis &Swinth, 2001).*Teacher must identify this fine motor skill in children. Many children show considerable improvement when exposed to this activities and are introduced to new practical activities *(Dankert, Davies, & Gavin, 2003).*Fine motor skill activities are performed after a period of time from the general motor skills, and activities that involve moving the bigger muscles of the body like shoulders, arms, pelvic and thigh, and especially for those activities that require holding weight with upper limbs. Some researches of the decades have shown that games play a very important role in physical, social and cognitive development at early stage in childhood *(Bergen, 2002; Garvey, 1993; Vygotsky, 1976).* Other researches show that active games are the base of the cognitive development of a child at early childhood and also the insufficient development of the motor skills can balk the academic learning in children. Early developments of the motor skills at children is a prediction of the cognitive abilities in the early age *(Piek,Dawson, Smith, &Gasson, 2008).* Another study indicates that when children where move in the meantime that they were learning, they activated more parts of the brain than in the cases when they just stood seated, in both cases these activities were led by the teacher *(James,et al., 2010)*.

A study of the motor and coordinative skills in children discovered that, when parents paid attention to their children while playing by focusing on an object or game and involving themselves in games like their children, the games become more complex and more valuable on the intellectual aspect *(Bigelow& Proctor, 2004)*. Pre-scholars with Down syndrome, who often have late development of the motor skills, express continuously liking during the game. Apparently, the nature of the inability of the child, the temperament, experiencing games in the family and social abilities affect the late emotional development *(Emck, 2009)*. The researches suggests that games and motor skills contribute in creating a relation during the first years of child growth. Children with lower coordination abilities tend to be involved less in friendships, games and sport parks *(Bar-Haim & Bart, 2006).* Obese pre-school children have less chances to be chosen by their peers to perform in group games, and sometimes tend to be excluded in games *(Musher-Eizenman& Edwards-Leeper, 2004).* The researchers suggest that generally the social enrolment occur on playgrounds than in indoors activities *(Bar-Haim & Bart, 2006).* Interaction between groups can promote the positive social cooperation during games. High quality game activities with parents and groups are accompanied with a bigger acceptance by their peers in classroom of pre-scholars *(Lindsey & Mize, 2000).*

3. Methodology

Participation in the study

From a total of 52 schools in the district of Tirana we have randomly selected 4 schools where the measurements are done. Classes also took place randomly selected at each school in this monitoring study. In this study, in the first measurements took into consideration 148 children in total, which constitutes 100% of the group. In the measurements of the second year (over a year) of the study took into consideration 148 children in total and the second measurement included the same children as the first one.

Measurements done

• The tests used to find out health parameters were: height, weight, BMI (kg/m2) and waist perimeter.

• Coordination abilities, for upper limps (plate tapping test; Eurofit 1993)

• Gross motor coordination, with KTK battery (Kiphard and Schilling, 1974, 2007).

a- Balance beam test, to measure balance
b- Jumping one leg test, to measure explosive power of lower limps
c- Lateral jumping test, to measure coordination of lower limps
d- Plate movement test, to measure coordination

• Motor abilities were measured with standing long jump, whichalso measure explosive power of lower limps and sit and reach test to measure flexibility.

Photo 1. Waist measurement

Coordination abilities

Coordination abilities of upper limbs (plate tapping test; Eurofit 1993)

The Plate Tapping Test (Reaction Tap Test) is a reaction test using an alternating wall tapping action which measures upper body reaction time, hand-eye quickness and coordination. This test is part of the Eurofit Testing Battery. The purpose was: to assess the speed and the coordination of upper limb movement. Equipment required: table (adjustable height), yellow discs (20cm diameter), rectangle (30 x 20 cm), and stopwatch.Procedure: If possible, the table height should be adjusted so that the subject is standing comfortably in front of the discs. The two yellow discs are placed with their centers 60 cm apart on the table. The rectangle is placed equidistant between both discs. The non-preferred hand is placed on the rectangle. The subject moves the preferred hand back and forth between the discs over the hand in the middle as quickly as possible. This action is repeated for 25 full cycles (50 taps). Scoring: The time taken to complete 25 cycles is recorded. The children performed the test twice and the best result is recorded.

Photo 2. Measurement of plate tapping test

Gross motor coordination, KTK Battery from (Kiphard and Schilling, 1974, 2007)

To measure Coordination, we have used the KTK battery, the German platform from (Kiphard andSchilling, 1974, 2007). This battery is used to measure gross motor coordination and Fine motor coordination.The Battery has 4 tests where each value is converted in a motor coefficient.

a- Balance beam test

To assess active balance we have used 'the Balance Beam Test', where the children are asked to walk along the entire length of a gymnastics balance beam without falling off, while they should show the ability to maintain balance while walking along the balance beam. Children are asked to start at one end of the gymnastic beam, walking along the length of it and then finish it to the other side of the beam. This test is repeated three times and the beams have different width 6.0 cm, 4.5 cm, and 3.0 cm, and where the score for each trial is the average of test overall score. To asses this sets we needed only one gymnastic balance beam and a stopwatch.

Photo 3. Measurement of balance, balance beam test

b- Jumping one leg test

To asses power of the lower limps we have used jumping one leg test, which is also part of the KTK- Body Coordination Test for Children. To perform this test children are asked to jump with one leg over an increasing pile of pillows. The surface of each pillow is 60 cm × 20 cm, and 5 cm high. The children are asked to jump over the mats from the lower level, 5 cm up to their maximum level which goes up to 12 level (5cm X 12). The maximum jump performed by each child with both right and left leg is recorded. The children are encouraged to jump as high as possible to show higher results. Assessing this test we have used only 12 mats 5 cm each

Photo 4. Measurement of jumping one leg test

c- Lateral jumping test

The lateral jumping test, was used to measure coordination and speed in lower limps. To realize this test was needed a flat space not slippery, a wooden tile to divide the space of two squares with (60 cm, 4 cm, 2 cm). Child jumps from side to side as many times as possible along one time 15 seconds. Multiply the number of jumps over two repeats of the test. Test-Coefficients the reliability of the rethinking; in the first grade (r = 0.87) and in the fourth grade (r = 0.91).

Photo 5. Measurement of lateral jumping test

Plate movement test

To asses coordination of lower limps we have used 'Moving with plates Test' which is part of KTK- Body Coordination Test for Children.

To asses this test children are asked to move / shift while walking over the two plates laterally as many times as possible. The overall test should be scored over a period of 20 seconds. The children are encouraged to move as much as possible over this period of time, without touching the feet on the floor. To asses this test the number of the moves children do on the plate in 20 second are recorded. To asses this test we have used only two plates and a stopwatch.

Photo 6. Measurement of plate movement test

Motor abilities, standing long jump test

Standing long jump, is part of the Eurofit tests, which is used to measure explosive power of the upper limps *(Eurofit., 1993).*In performing the standing long jump, the jumper stands at a line marked on the ground with the feet slightly apart. The athlete takes off and lands using both feet, swinging the arms and bending the knees to provide forward drive. The measurement used was the longest of three tries. The jump must be repeated if the athlete falls back or takes a step at take-off.

Photo 7. Measurement of standing long jump test

b. Sit and reach test, flexibility test

To measure Flexibility we have used the sit and reach test, it also measure the hamstring muscles flexibility (The CooperInstitute, 2007). Participants were instructed toreach as far as possible with one leg straight whilesitting at a sit-and-reach box, while keeping the legsstraight, bends forward as far as possible.

Photo 8. Measurement of flexibility, sit and reach test

4. Statistical analysis

Statistical Analyses was conducted using IBM SPSS Statistics 22. Pre and post scores for the dependent variables were analyzed using descriptive and inferential methods. The analysis of pre and post measurements were performed by comparing means of dependent variables. T-tests were used to identify and statistically evaluate a possible change as a training effect.

Descriptive Statistics methods included:

− Descriptive Statistics summary tables (Mean, standard deviation, minimum, maximum, Standard deviation, skew, kurtosis, standard error of skew, standard error of kurtosis etc.)

− Frequency tables

− Bar Charts

Data distribution was presented using histograms and box-plots.

Inferential Statistics methods included:

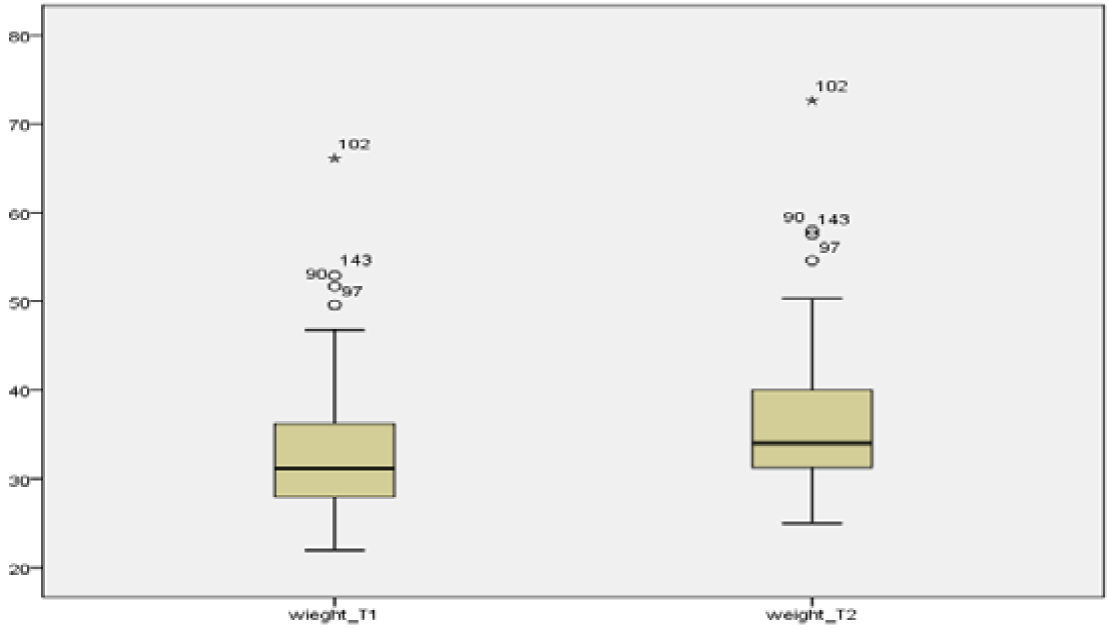
− Testing against normal distribution using normality tests – Kolmogorov - Smirnof and Shapiro-Wilk.

− Testing research hypotheses, in order to statistically evaluate a possible change between pre and post measurements using t-tests for weight, height, body mass index, waist, plate tapping test, balance test, jumping one leg test, lateral jumping test, plate movement test, standing long jump test and flexibility test.

− Reliability analyses using bi variat correlations between measurements.

5. Results

In defining the body weight a stadiometer was used, a total of 148 children were part of the study in the first and second year, but only 93 children which is 62% of the total were present on the day of measurement and 55 children which is 37% were missing on that day. On the first year the minimum value of body weight was 22 kg, the average value was 32 kg and the maximum value was 66 kg. On the second year the minimum value of body weight was 25 kg, the average value was 36 kg and the maximum value was 72kg. While standard deviation values were 7.3 in the first year and 8 in the second year. The median has an incensement value from 31 kg in the first year to 34 kg in the second year. *Graphic 1* indicates the box plot of body weight of children in first and second year.

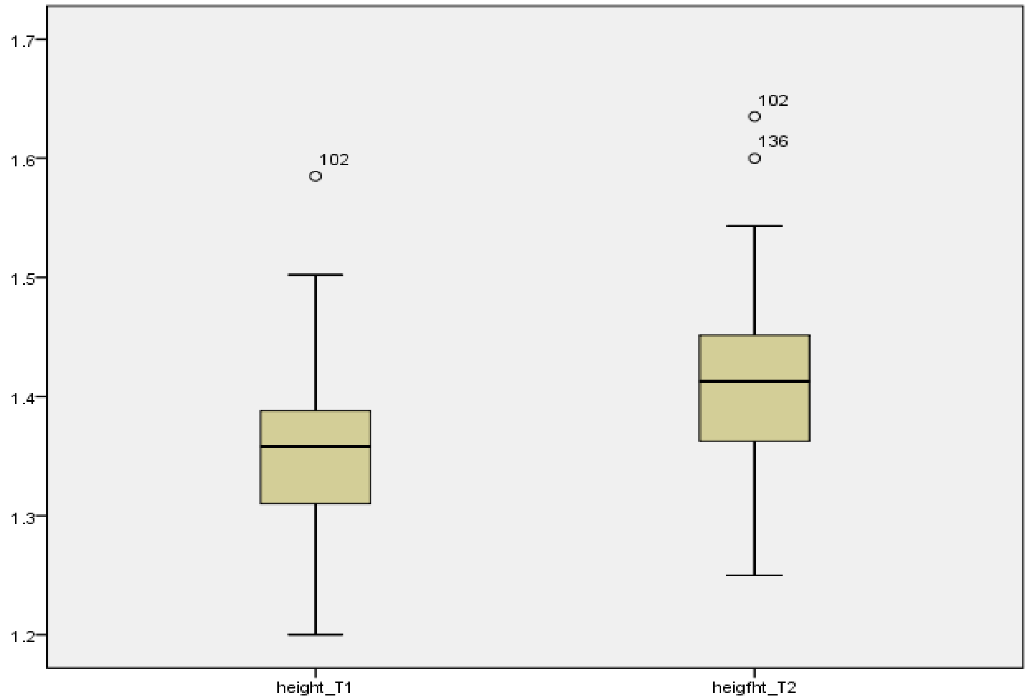


Graph 1. Box plot of weight in the first and second year

The results of the descriptive statics analysis of body height, indicates a development of body height increase from measurements in T1 to T2. In T2 an incensement of 3.9 kg was evidenced, the height variable varies from (32.65 ± 7.34) kg in T1 to (36.56±38.08) kg in T2. The results of the t-test were (t (92) = ***- 15.157,*** p < 0.000.5), which evidenced an important statistical difference between two measurements, were the ($p < 0.05$), leading us to this statistical conclusion that the body height in children is significant with increase of (+3.9 kg).

Body height

In defining the body height a stadiometer was used, a total of 148 children were part of the study in the first and second year. On the first year the minimum value of body height was 120 cm, the average value was 135 cm and the maximum value was 159 cm. On the second year the minimum value of body height was 121 cm, the average value was 141 cm and the maximum value was 164 cm.

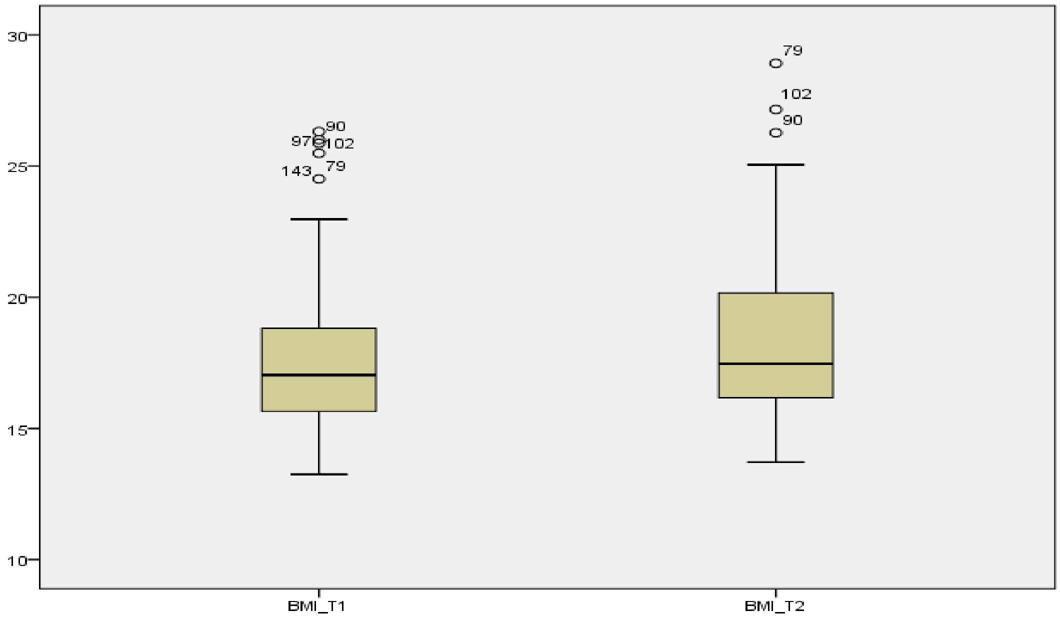


Graph 2. Boxplotii body heightin the first and second year

The results of the descriptive statics analysis of body height, indicates a development of body height increase from measurements in T1 to T2. In T2 an increase of 6 cm was evidenced, the height variable varies from (1.35± 0.06) cm in T1 to (1.41±0.07) cm in T2. The results of the t-test were ($t(91)= -19.038$**,** $p < 0.000.5$), which evidenced an important statistical difference between two measurements, were the ($p < 0.05$), leading us to this statistical conclusion that the body height in children is significant with 6 cm.

Body mass index

In defining the body mass index a stadiometer was used, a total of 148 children were part of the study in the first and second year. On the first year the average value of body mass index was 17.7 kg/m^2 while in the second year the average value was 18.2kg/m2.

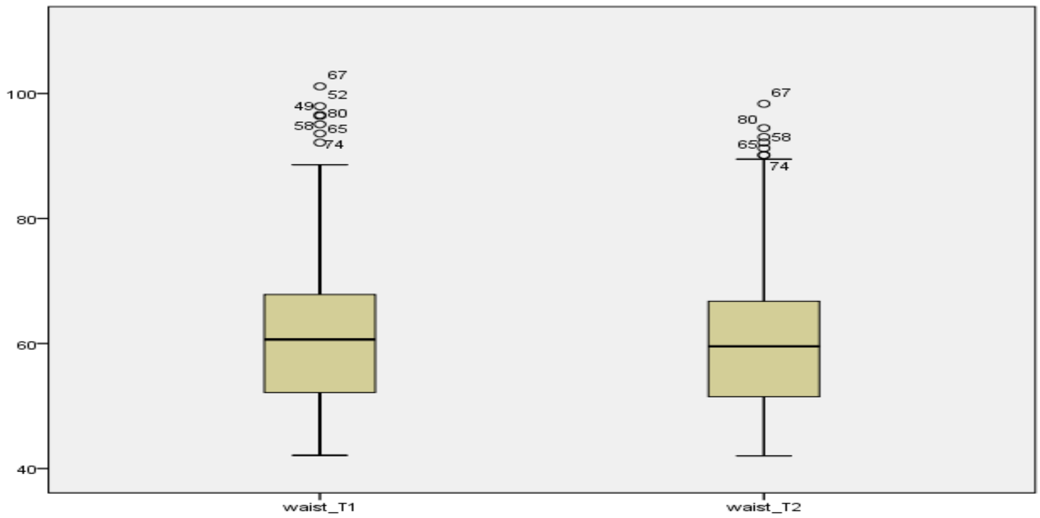


Graph 3. Boxplot of BMI in the first and second year

Graph 3 shows the Box plot of the values derived from the results of Body mass index. The results of the descriptive statics analysis of Body mass index, indicates a development of body mass increase from measurements in T1 to T2. In T2 an incensement of 0.6 kg/m2 was evidenced, the body mass variable varies from (17.7 ±2.8) cmin T1 to (18.2 ± 3.02) cm in T2. The results of the t-test were ($t(91)= -4.26, p < 0.000.5$) which evidenced an important statistical difference between two measurements, were the ($p < 0.05$), leading us to this statistical conclusion that the body mass in children is significant with increase of 0.6 kg/m^2.

Waist perimeter

The measurement of the waist perimeter is performed with a tape meter. Children take off their clothes so that the waist is loose and free of clothes. The summary of statistical descriptive results indicates that the average of the waist circumference values in children tested in the first year is 61 cm andin the second year is 60 cm, i.e. 1 cm more. In the first year, the minimum value of the waist circumference is 42 cm of the tested children, while the maximum values are 101 cm, whereas in the children tested in the second year these the value is 42 cm and a maximum of 98 cm.

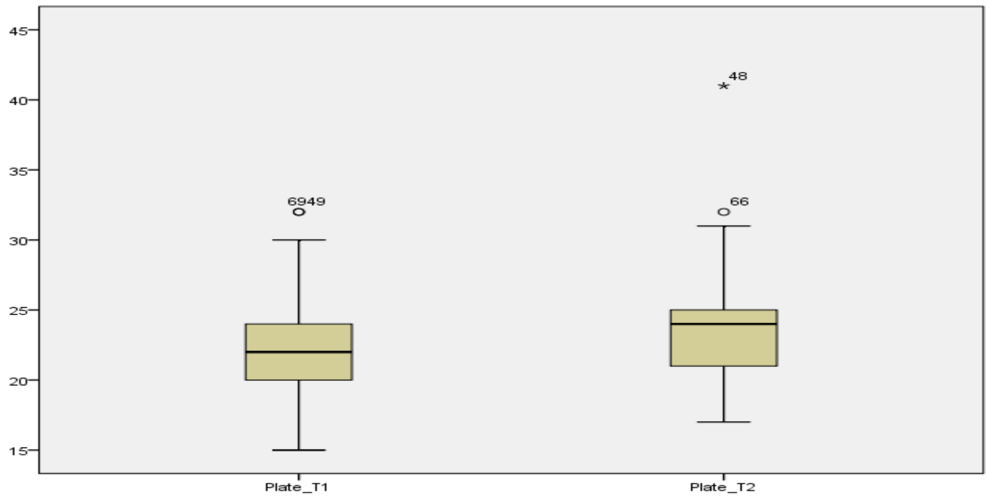


Graph 4. Boxplot of waist in the first and second year

Graph 4 shows the Box plot of the values derived from the results of waist perimeter. The results of the descriptive statics analysis of waist perimeter indicate a development of waist, which increased from measurements from T1 to T2. In T2 an incensement of 1 cm was identified, the body mass variable varies from (61.8 ± 12.85) cm in T1 to (60.8 ± 12.40) cm in T2. The results of the t-test were (t (123)= 5.685p < 0.000.5) which evidenced an important statistical difference between two measurements, where ($p < 0.05$), leading us to this statistical conclusion that the waist perimeter increased by 1 cm, which is a significant difference.

Platte tapping test

Plate tapping test, a coordination test for the upper limbs, was performed by 148 children both in the first and second year. In the first year only 68% or 101 children performed the Plate Tapping test while 47 children, 31%, were absent during this test. Even in the second year only 68% of the children took the test.In the first year the minimum value of coordination is 15, while the maximum value is 32 and the mean value is 22. Moreover, the median for balance test in the first year is 22, while standard deviation is 3.5.In the second year the minimum value for balance is 17 and the maximum is 41. The mean value of the balance test is 32, while the median is 24 and standard deviation 3.5.

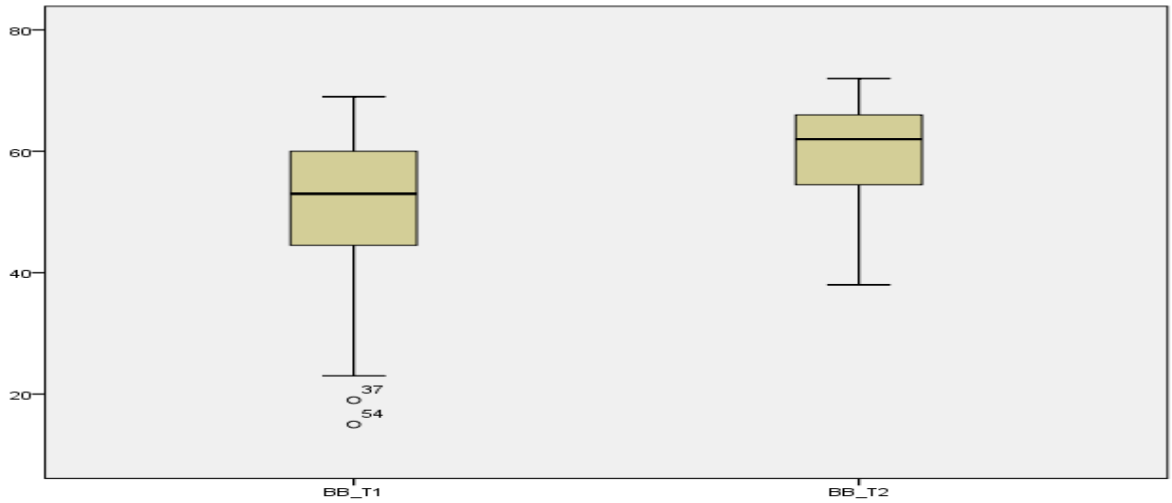


Graph 5. Boxplot of plate tapping in the first and second year

Graph 5 shows the Box plot of the values derived from the results of platte tapping test, which identifies coordination skills in the upper limbs, this test was carried out in the two years of our study. The comparison of the variables Time1 and Time2 with the T-tests for the Plate tapping The results derived from the descriptive statistical analyses identify that there has been decrees in coordination comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the plate taping test. PPT variable varies from (22.01 ± 3.51) sec at T1 to(23.78 ± 3.58) when measured at T2. Results of dependent t-test ($t(100)=$ ***- 4.594,*** $p =$ 0.000) pointed out a significant difference between the two measurements ($p < 0.05$), leading to the conclusion that the development of coordination of upper limps in children identified by plate tapping is not considerable.

Balance beam test

The subject of this study are 148 children, but only 95 of them have participated in the balance beam test in the first year, which is 64% of the overall group, 53 children which is 35 % of overall group were absent. Also in the second year from a total of 148 children only 95 children or 64 % of the group were tested and measured while the others were absent on the day of the Test. A descriptive statistical analysis on measured balance ability, with balance beam test on the first and second year is shown. As it is evident in the, in the first year of measurement the minimal value of Balance is 15 steps, while the maximal value is 69 steps with a mean of 51 steps. While in the second year children have shown a minimal value of 38 steps and a maximal value of 72steps with a mean of62 steps.

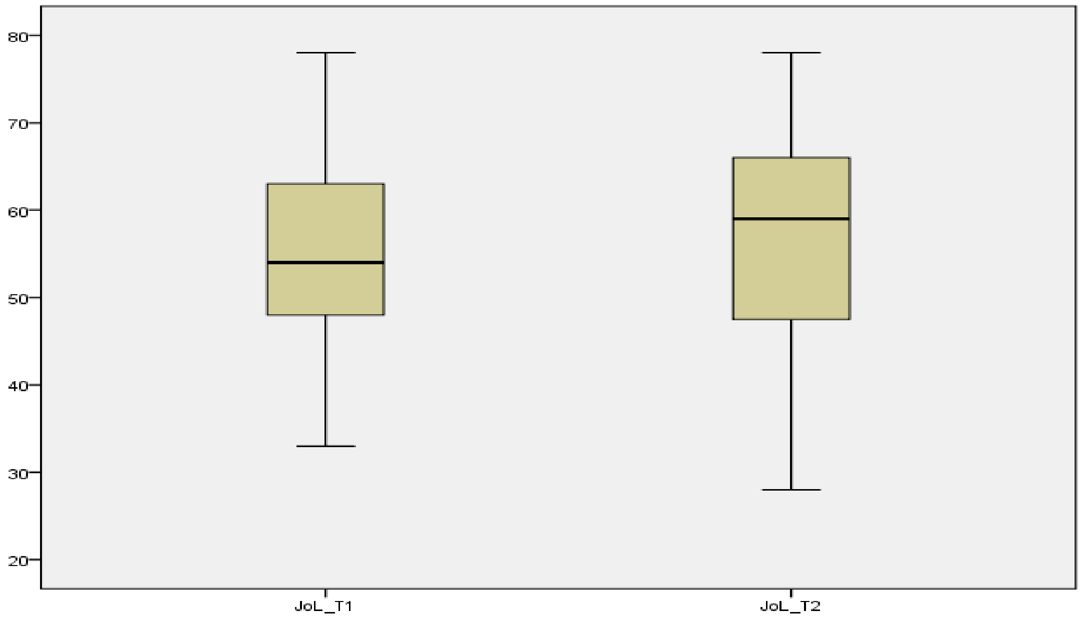


Graph 6. Box plot of balance in the first and second year

In Graph 6 we can see the Box plot of both years which shows the values of minimal, maximal and mean number of steps of the children who have performed the balance beam test.The results derived from the descriptive statistical analyses shown in that there has been a positive development of the balance comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the balance beam test. BBT variable varies from (51 ± 11.9) cm at T1 to (60 ± 8.16). The comparison between the two measurements for Balance was carried out using the dependent t-test. Results of dependent t-test ($t(94) = -7.543$, $p < 0.000.5$) pointed out a significant difference between the two measurements (p < 0.05), leading to the conclusion that the development of balance in children identified by Balance Beam is considerable with 9 steps.

Jumping one leg test

Measuring explosive power of lower limps we have used jumping one leg test in first (T1) and second (T2) year, where in both years have participated in test 92 children which is 62 % of the group of 148, where in the day of test have missed 56 children.

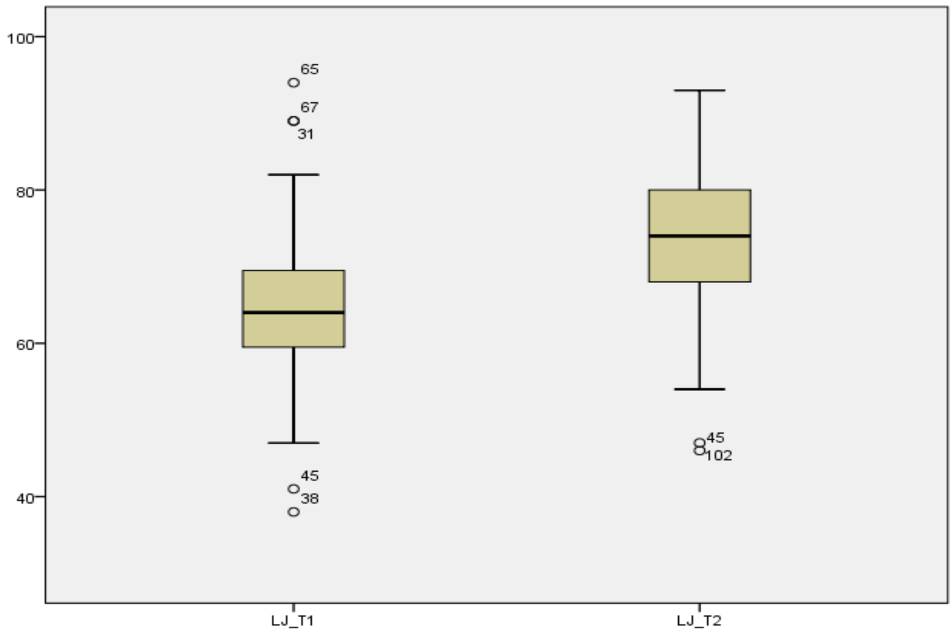


Graphic 7. Box plot of jumping one leg beam test in the first and second year.

In Graphic 7 we can see the Box plot of both years which shows the values of minimal, maximal and mean values of Jumping one leg in cm. The comparison of the variables Time1 and Time2 with the T-tests for jumping one leg. The results derived from the descriptive statistical analyses shown in Graphic 7 identify that there has been a positive development of the jumping comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the jumping with one leg from 2.75 cm. JoL variable varies from (53.97 ± 9.96) cm at T1 to (56.72 ± 13.26) cm when measured at T2 as shown in graph 7. The comparison between the two measurements for Jumping was carried out using the dependent t-test Results of dependent t-test ($t(91) = -3.559$, p .001) pointed out a significant difference between the two measurements ($p < 0.05$), leading to the conclusion that the development of Jumping in children identified by Jumping test is considerable with 2.75 cm .

Lateral Jumping test

Only 104 children from 148 of them have participated in the Lateral Jumping test in the first and second year, 44 children have absent in the day of measurement which is 29 % the group. In descriptive statistical analysis, on the first and second year, and as it is evident in the, in the first year of measurement the minimal value of lateral jumping is 38 Jumps while the maximal value is 94 jumps with a mean of 64 jumps. While in the second year children have shown a minimal value of 46 jumps and a maximal value of 93 jumps with a mean of 73 jumps.In Graphic 8 we can see the Box plot of both years which shows the values of minimal, maximal and mean number of jumps of the children who have performed the test.

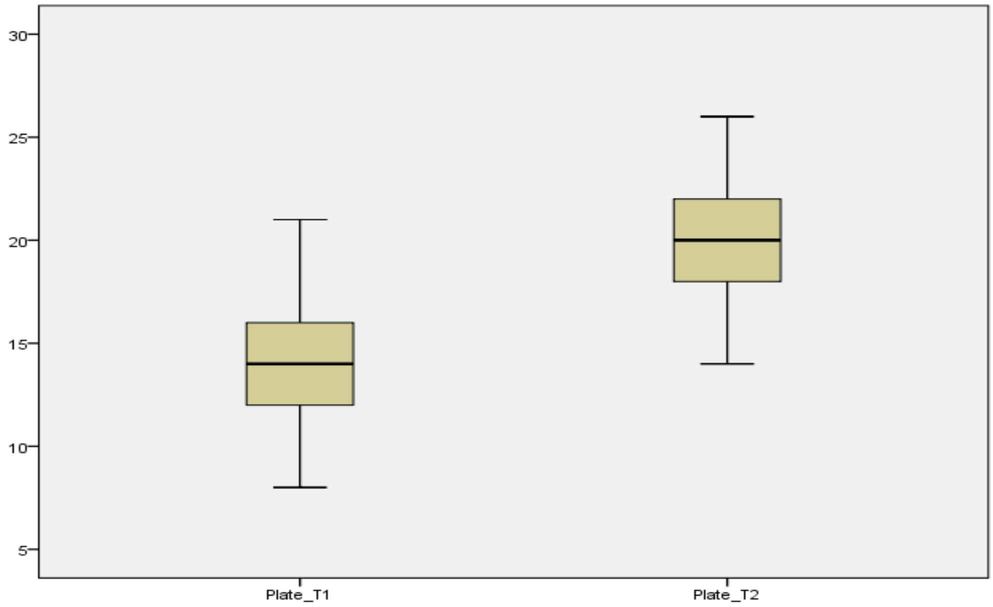


Graphic 8. Box plot of lateral jumping test in the first and second year

The comparison of the variables T1 and T2 with the T-tests for the lateral jumping test. The results derived from the descriptive statistical analysesidentify that there has been a positive development of the jumping comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the lateral jumping test, where the variable varies from (64.18 ± 9.25) cm at T1 to (73.54 ± 9.07). The comparison between the two measurements for lateral Jumping test was carried out using the dependent t-test. Results of dependent t-test ($t(103) = -10.436$, p .000) pointed out a significant difference between the two measurements ($p < 0.05$), leading to the conclusion that the development of coordination of lower limps in children is considerable with 9.3 jumps.

Plate movement test

A summary of the descriptive statistic for measuring the co-ordination ability through the plate movement test performed in the two years of the study result to be, the maximum of the coordination test are 21 displacements, as well as an average value of 14 shift. In the second year the children presented minimal values of 14 displacement and values maximum 26 displacement.



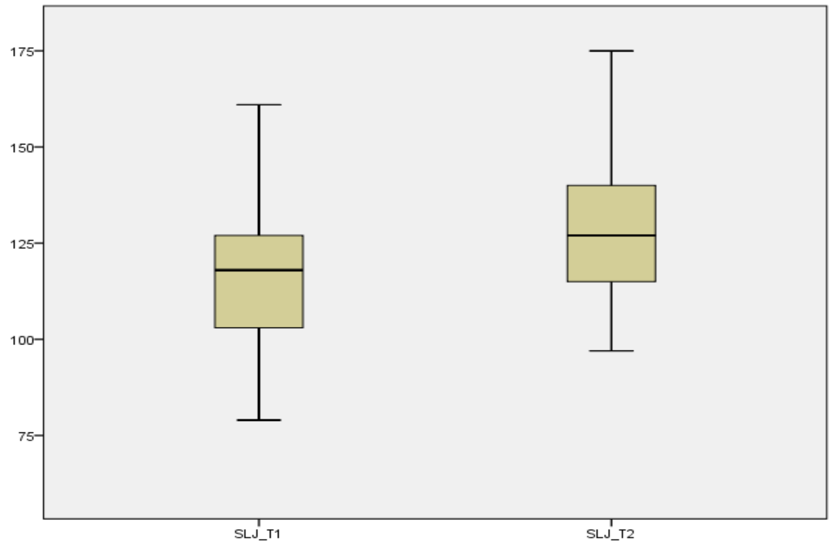
Graph 9. Box plot of plate movement in the first and second year

The comparison of the variables T1 and T2 with the T-tests for the plate movement test. The results derived from the descriptive statistical analysesidentify that there has been a positive development of the movement comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the plate movement test, where the variable varies from (14 movement ± 2.96) at T1 to (20 movement ± 2.75)The comparison between the two measurements was carried out using the dependent t-test. Results of dependent t-test ($t(94)= -17.532$, $p < 0.000.5$) pointed out a significant difference between the two measurements ($p < 0.05$), leading to the conclusion that the development of coordination of lower limps in children is considerable with 6 movement more.

Standing long jump test

In the standing long jump in the first and second year were measured 102 out of 148 children. From processingdata, we found out that the average values of the standing long jump tested in the first year was 117 cm and in the second year was 128 cm.

In the first year the minimum value was 79 cm while in the second year this value is 97 cm. The maximum value of standing long jump in the first year is 161 cm and in the second year this value is 175 cm. The median of the children tested in the first year is 64, while the median in the second year is 74.

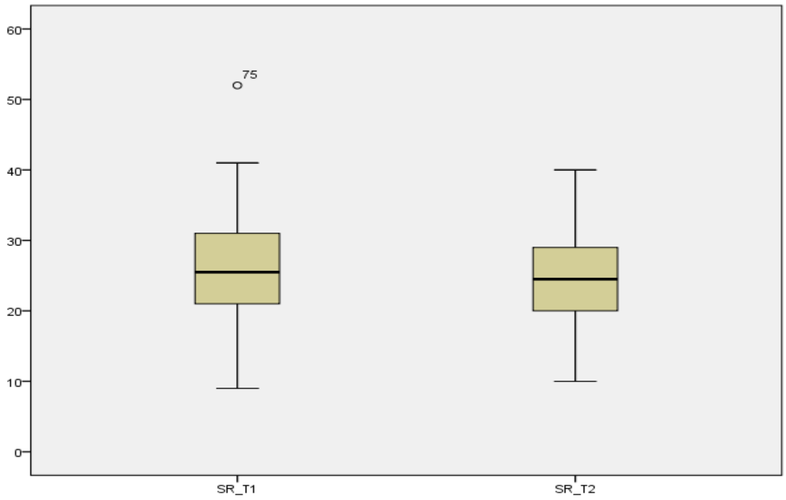


Graph 10. Box plot of standing long jump in the first and second year

The comparison of the variables T1 and T2 with the T-tests for the standing long jump test are showed in the box plot 10. The results derived from the descriptive statistical analyses identify that there has been a positive development of the jumping comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an increase in the standing long jump test, where the variable varies from (117 ± 15.87) at T1 to (128± 16.49). The comparison between the two measurements was carried out using the dependent t-test. Results of dependent t-test ($t(101) = -8.21$, $p < 0.000$) pointed out a significant difference between the two measurements($p < 0.05$), leading to the conclusion that the development of power in the lower limps in children is considerable with 11 cm more.

Sit and reach test

Sit and reach test is used to measure flexibility of the lower limps. In the first year the minimum value of flexibility is 9, while the maximum value is 52 and the mean value is 25. Moreover, the median for flexibility test in the first year is 25, while standard deviation is 7.2.In the second year the minimum value for flexibility is 10 and the maximum is 40. The mean value of the balance test is 24, while the median is 24.5 and standard deviation 6.4.



Graph 11. Box plot of flexibility in the first and second year

Graph 11, shows the box plot of flexibility in first and second year, where results derived from the descriptive statistical analyses identify that there has been a **decrease in the flexibility** comparing the measurements done at T1 and then in T2. At the time of the T2 it is observed an decrease in the flexibility with 1.03 cm, where the variable varies from (25.4±7.2) cm at T1 to (24.4±6.4) cm. The comparison between the two measurements was carried out using the dependent t-test. Results of dependent t-test ($t(91)=$ ***1.62,*** $p = 0.109$)pointed out a significant difference between the two measurements ($p < 0.05$), leading to the conclusion that there is no development in flexibility in children, so is a decrease with 1.03 cm.

6. Discussion

Body mass index

BMI it is the index that is very easy to evaluate and appropriate for the aims of our study, which proposes a number of limited fitness tests which easy to be applied even in schools*(Vajda et al. (2007).* The results of the descriptive statics analysis of body weight, indicates a development of body weight incensement from measurements in T1 to T2 with in 3.91 kg and body height with6 cm from T1 to T2. The BMI value in children of the first year was increased from 26.3kg/m^{2}to 28.9 kg/m^2 .Obesity and lack of physical activity, can influence the growth in children and the role of school it very important to motivate and educate them to a healthy lifestyle*(Aga 2004).*We can say that the lower motor coordination ability it is related to higher fat percentage in body mass. Indentifying at an early age the lower motor coordination ability or higher fat percentage in the body mass it is important in applying and developing healthy behavior *(Lopes et al.,2015)*. The results of the t-test were (t(91)=***-4.26,*** p <0.000.5), which evidenced an important statistical difference between two measurements, were the ($p < 0.05$), leading us to this statistical conclusion that the body mass index in children is significant with an increscent of 0.6 kg/m^2.

In the study of *Albertini et al., 2007,* the anthropometric measurements and the distribution of values of BMI shows that overweight and obesity has increased 24.3% of children overweight, 9.7% were obese. Comparing the results of this study about nutrition in children of the same age shows that the general trend is deteriorating.

Valdivia et al. 2008a shows in her study was noticed that overweight and obese children had lower performance in the motor coordination ability compared to their peers with the same body weight, and this influenced directly in body mass index in weight lifting, games and general motor coordination skills.

Changes regarding the BMI and general motor coordination skills, it noticed that they are highlighted in the late childhood that then in the beginning of adolescence. Children with different motor coordination ability level change even the level of physical activity ash showed in the study of *Lopes et al. 2011,* that children who belong to a group of high motor coordination ability also had a higher level of physical activity. The results of the descriptive analysis for the

Coordination ability in upper limbs

Comparing the two measurements in the ability of the coordination of the upper limbs (plate tapping test) was realized through a t-test. The results of the t-test were ($t(100)=$ ***- 4.594,*** $p = 0.000$), which evidenced an important statistical difference between two measurements, were the ($p < 0.05$), leading us to this statistical conclusion that the improvement of upper limbs in children from T1 to T2 were significant with an decrease from 20 to 23 sec.

Eurofit test battery and especially the plate tapping test measures speed and coordination of the upper limbs, is a test that contains measurement units for the bigger and smaller motor coordination skills, and it is especially used to identify children that might have motor coordination skills problem. Higher body mass can increase the power of the upper limbs, as a result have a better performance in medicine ball throwing *(Korsten-Reck et al., 2007).*

On the other side the study of *Brunet et al., 2007,* have found out that overweight and obese children performance in weight lifting, jumping and running is lower.

Regarding physical education and sport, it would have been valuable and very useful and a trustful instrument which measures motor coordination skills in children, thus measurements are done independently from the physical capacity of children. This instrument was used in a practical and simple way by physical education teachers to measure overall motor coordination in children *(Ulrich, 2000).* KTK "Korperkoordinations Test fur Kinder" it is a qualitative instrument created by Kiphard and Schilling that is used to measure overall motor coordination skill in normal children and in deficiency motor coordination skill children which help physical education teacher to identify children that might have motor coordination skills problem

Gross motor coordination

The numerous studies that have been conducted, mainly in Germany, show that there has not been a significant decrease in the coordination level in the past 30 years. *(Kretschmer, 2003; Henderson & Sugden, 1992)*.

The comparison of the two measurements of dynamic balance was carried out by dependant t-test (table 47). The results of the dependant t-test (t (94)= ***- 7.543,*** p < 0.000.5) identified e statistically significant difference between the two measurements ($p < 0.05$), thus reaching the conclusion that the development of the dynamic equilibrium, identified by the balance beam test, is significant and it improved by 8.6 steps.

The results of the descriptive analysis for the explosive strength and coordination of lower limbs, identified by hopping on one leg test, shows there has been a development of the power and coordination improvement of the lower limbs in children between the two measurements T1 and T2. At T2 it is marked an increase by 2.75 cm of the hopping on one leg. Hopping on one leg variable varies from (53.97 ± 9.96 cm) at T1 to (56.72 ± 13.26 cm) at T2. This study leads to the conclusion that there has been a statistically significant difference by 2.7 hops from T1 to T2. Jumping sideways was used to evaluate temporary coordination and it is part of the coordination test KTK and it is valid for children aged 5 to 14. Both KTK test and hopping sideways have been well documented and used to test school children in Germany *(Graf et al., 2004a,b)*.

The comparison of the two measurements of hopping sideways was carried out by making use of dependent T-test. The results of this test (t (103) = -10.436**,** p .000) identified a statistically significant difference between the two measurements ($p < 0.05$) allowing us to conclude that there was a significant improvement of hopping sideways by 9.3 hops between T1 and T2. Comparison of the two measurements for plate movement was carried out by using the dependant T-test, the results of which (t (94)= -17.532**,** p < 0.000.5) identified a significant difference between two measurements, and thus we can conclude that there has been a development by 6 movements from T1 to T2 in other words a better coordination of the lower limbs in children.

In corroboration with our study is that of *Vandorpe et al. 2011*, which noticed that the performance in the four tests increased significantly with increasing age, and the follow-up analysis showed that each of the age groups performed better than the one-year younger age group. Girls also had better result than boys in walking backwards and hopping on one leg. The data of the above study and our study regarding walking backwards and hopping on one leg that represent development patterns correspond with each-other but they are contradicting when it comes to gender-specific differences.

Motor skills

The descriptive analysis for the standing long jump scores, used to measure explosive strength, identifies a progressive performance by children in this test form T1 at T2. At T2 there is an increase by 11 cm for standing long jump thus the study shows a development of explosive strength in children. Body weight seems to influence less the lower back flexibility, tested by sit and reach, or the capacity for dynamic coordination in the whole body. The data derived by the questionnaires show that a huge percentage (81.9% of the boys and 78.7% of the girls) of the respondent children practice sport, while the other daily activities are mainly sedentary in nature. Other studies conducted in Italy have shown high levels of sedentary lifestyle led by children, and that this lifestyle is more common or higher in percentage in girls than in boys *(Italian Statistic Office, 2007; National Center of Epidemiology, Surveillance and Health Promotion, 2008).* The statistical descriptive analysis of the flexibility test showed a decrease in scores from T1 to T2. The measurements at T2 mark lower flexibility by 1.03 cm. The sit and reach test variable is (25.4±7.2) cm at T1 while at T2 it is (24.4±6.4) cm.

In conclusion, we think that children need a higher level of fine and gross motor skills, i.e. running, dancing, writing, drawing, etc, in order to fulfill the requirements and tasks at school, home as well as at the playground or other sports and social contexts *(Losse et al., 1991).* If motor development is low or insufficient, this might hamper the development of motor skills, as well as affect academic achievement at school, interaction with peers, physical and social activity, as well as success within the groups they belong. Children with gross motor discordance have a lower activity level, which on the other hand, will limit their chances to develop motor competence through participation in such activities *(Bouffard et al., 1996).*

After the comparison of data of this study with those of Belgian *(Vandorpe et al., 2011)* and German children *(Kiphard and Schilling, 1974)* it was noticed that for the Portuguese boys and girls the T-test scores were lower when compared to Belgian counterparts on hopping on one leg and jumping sideways, while the results of the balance test was the other way round. In plate moving test, the Portuguese boys performed better than their Belgian peers at 6, 8, 9, and 10 years old, but girls scored lower at this test. A similar trend was observed when using one sample t-tests with the German mean as the reference value. Portuguese children scored significantly lower than the German sample for balance test (girls), hopping on one leg, jumping sideways, and plate moving. This result is an important revelation, given the time gap of 32 years between our study and the German sample. It was expected that the increased standard of living, opportunity for practice and instruction, and learning, experienced by the Portuguese children in the last decades, could lead to similar or higher scores of gross MC. However, recent studies also demonstrated that changes in fat mass *(Krombholz, 2013)*, physical activity *(Vandorpe et al., 2012)*, sedentary behavior *(Lopes et al., 2012b)*, and physical fitness *(Tomkinson et al., 2012)* in recent years might have affected these results.

The findings of this study show that everyday physical activity and participation in organized sports improve physical performance of children and especially boys. As a fact, boys who regularly participate in organized sports performed better in the tests of explosive strength in the upper limbs, speed, anaerobic strength and that of flexibility. Whereas, in girls the physical performance is higher in those that engage in sports and physical activities, than in those that do not participate in such activities. The biggest difference is noticed in the flexibility test. In this logic, we can raise the hypothesis that sports played by boys such as: basketball and football and the kind of physical activity they are exposed to in their free time, compared to the ones practiced by girls like: dancing, gymnastics, can lead to a greater development of physical skills. The use of fitness tests, which are easy to apply at school environment, must be applied at elementary schools to identify children with a low fitness level as well as to encourage a healthy lifestyle. The fitness tests selected and used in this study seem to be appropriate for the evaluation of basic physical skills of conditioning and coordination at this age group. These tests except being verified and validated at an international level, they are also easy to apply as they do not make use of special equipment or facilities. Moreover, they are associated with anthropometric features and physical activity habits of children. In contrast with earlier studies *(Bappert et al.,2003), this specific study did not find a relation between motor skills and BMI classifications for pre-school children.*

Underweight boys were less flexible at the seat and reach test. The study conducted by (*Bappert et al.,2003)* is the only one which can prove that obese and overweight pre-school children have a lower performance level at the flexibility test. The subjects of the abovementioned study included 1,288 kindergarten children as part of the project on ‘Children’s health’. In the group of children studied by them it was noticed that normal-weight children achieved better results at long jumping and hopping sideways than overweight children. Overweight children demonstrated a higher flexibility at ‘sit and reach’ test. This can be explained by the fact that heavier weight because of the gravity increases stretching ability and thus a better performance at flexibility tests. This study demonstrated a significant difference between underweight boys and the ones who belong to the other weight categories.

These differences were made evident by the 'sit and reach' test, in this way the result can not be justified by gravity factor. Meanwhile, the study of *Butterfield et al.,* 2002 focused on the relation of BMI and qualitative execution of basic motor skills such as: running, jumping etc. and the scores of some exercises such as: hand-grip power, steps tests, sit-ups, sit and reach, in a group of 65 children aged 5-8. The results showed that BMI did not influence the test results, and only the scores of 'sit and reach' test can be compared to the study in question. The researchers reached the conclusion that the development of motor skills at this age depends on other factors such as participation in different activities. The BMI at the fitness test showed a positive relation with strength test of hand-grip and a negative relation with sit-ups within 1 minute. The pulse rate at the steps test and flexibility at 'sit and reach' test did not show any relation to BMI.

Likewise, even other studies of kindergarten children focused on anthropometric parameters and motor skill did not find a relation between BMI and performance of motor skills.

Such a relation can be noticed with increasing age and the study did not notice age-related difference. However, the study of Graf et al., 2004 & Graf et., al 2003 identified a far worse performance of overweight and obese children at first grade. In order to have a normal activity at everyday life children need to posses sufficient level of motor coordination skills and especially a very good development of motor skills. Moreover, the study of *Graf et al. 2004* reveals that children who exercise more achieve a higher level of motor coordination. Participation in sports is an efficient way to increase physical activity as well as to improve the development of basic motor skills in children. Moreover, participation in sport relates with the high level of gross motor coordination *(Fransen et al., 2012; Vandorpe et al., 2012),* and also plays a major role regarding its level in the future of children *(D'Hondt et al., 2013).* It is known that the achieved level of performance of a number of basic motor skills, strength and performance improve with increasing age up to adolescence, thus the gradual improvement of performance in the test of general motor coordination is not unexpected as it is general phenomenon *(D'Hondt et al., 2011b; Vandorpe et al., 2011)*. It should be highlighted that there are contradictions regarding gender-related differences. In the group of children observed by Kiphard and Schilling there were no differences between boys and girls in walking backwards and moving sideways. These results confirm the findings of or study as regarding walking backwards but not the findings for moving sideways test.

The final results of the one-year monitoring of motor skills in children at elementary school reveal a clear picture of the progress of these skills along one academic year. The results demonstrate improved coordination skills which activate the big muscles, otherwise called gross skills, as well as explosive strength. It is not noticed any increase in the level of fine coordination skills of the upper limbs, on the contrary, the results show that there is a decrease in the measured values, as well as it does not testify any improvement of flexibility. Moreover, it is evident an increase of the mean value of weight, height and of body mass index.

The data derived by this monitoring study leads us to the conclusion that it is needed professional effort and intervention in the physical education classes by the PE teachers and not general teachers.

The measurements, i.e. the tests do not show an enhancement of those motor skills which require a more careful preparation and detailed planning of the PE classes. The children, subject of this study, had a development of those skills which require the activation of the main/gross muscles and which can be improved only when children participate actively in general plays or games.

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