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# INTERACTION BETWEEN THE VARIABLES MOTOR COORDINATION AND BIOLOGICAL MATURATION WITH THE SCHOOL PERFORMANCE ON CHILDREN (FROM 05 TO 12 YEARS OLD) IN MUNICIPAL SCHOOLS FROM CACOAL / RO (BRAZIL).

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**Abstract:**-The engine behavior is not a function of the environment, but is molded to its characteristics. The objective was to analyze the influence between the variables motor coordination and biological maturation, and the school performance in students from 5 to 12 years old from the city of Cacoal / RO. The current study has observational, qualitative and quantitative features. After applied the criteria for inclusion and exclusion the sample was a total of 389 children aged 5-12 years old. For motor coordination it was used TGMD-2 test, developed by Ulrich (2000) and validated by Valentini et al., (2008). To obtain data on sexual maturation were used TANNER stages (1976), validated by (Matsudo and Matsudo, 1986). For school performance, we used the six-monthly average of Portuguese and mathematics disciplines. For the analysis of sample normality, we used the Kolmogorov-Smirnov test (Marôco, 2007). And for tabulation and application of data, we used the SPSS 17.0 program (Marôco, 2007). When evaluated the overall motor skill, it can be seen that the average score was 5.9 on where they fall below the average and standard deviation +-1.2. In variable biological maturation, the sample was on the score 1.9 on pubic hair in boys and 2.1 in breasts in girls, where they fall between levels 1 and 2 when checked the pubic hairiness and 2 in the breasts, that is, fitting in pre-pubescent stage in both genders. And when we verified the chronological age of the sample, it could be seen that the average was 8.7 years and standard deviation of + - 1.9 years. In the academic performance of the Portuguese notes were averaging 74.2 + - 3.4 and mathematics 71.2 + - 3.1. Therefore, in theory, it could be seen in the current study that motor ability was influenced by chronological age, biological maturation and math note factors.

**Keywords:** Educational Performance; Motor coordination; Biological maturation.

## INTRODUCTION

The preschool age covers the period from about 3 to 6/7 years old and it is called the "the golden age of childhood." This age group is characterized by a high impetus for movement and play, a marked curiosity about all that is known (GRUMBACH and Styne, 2003).

The start of formal schooling is an important change in the child's motor development. The school means the beginning of the period in which one must learn all the skills and specific roles that are part of their culture (Bohme, 2002). According to Cole et al., (2000), childhood is the period of construction in which the motor development is being built. And the development of motor skills in the fundamental movement phase depends on

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many stimuli from the environment. Additionally, specialized motor skills are the result of the improvement and refinement of the motor skills established in the phase of fundamental movements.

Children are naturally active and the playing in their daily routines, involve much physical activity. But children living in the city who lives in apartments, have changed the lifestyles, displaying changes in the usual playing. Activities such as TV, video games, computer, have changed the daily lives of children implying the experience of sedentary lifestyles. In a study by Teixeira et al. (2005) showed that 75% of the children were sedentary, or just did the school physical education. Also in this study 85% of the sedentary children, spent more than 3 hours per day in front of TV and video games. Silva et al., (2007), stated that 36.1% of the children were insufficiently active, and the average time spent with TV was 3.7 hours.

Also, the study performed by Giugliano (2003) showed that 60% of the children were sedentary and passed 3.2 hours in the front of the TV. And 86% of the children were classified sedentary with overweight. For the same authors, obesity and overweight of these children should be treated as a public health problem, because they can result in several future metabolic disorders.

To Romanholo (2008), the health problems associated with excess body fat, is not a risk factor for adults only. There are indications that children with relative body fat higher than 30% for girls and 25% for boys, are at moderate to high risk for the development of coronary heart disease. This excess of body weight according to Polônio (2003), may be due to changing lifestyle of children, where the change in lifestyle also implies a reduction of physical effort expended at work (which is good), also increased by a reduction in active leisure, traditional in all previous cultures to television and "games" (which is bad).

Thus, the research is justified to characterize the variables that influence motor skills in children of school age, thus showing the importance of having public policy actions aimed at children's physical education, which enable children to potentiating their motor skills.

Thus, the proposed objectives were to analyze the influence of the variables: school performance and biological maturation in motor coordination on school children in Cacoal / RO (Brazil). And characterize the school level of biological maturation (sexual), motor performance, and school performance; verify the association between motor performance and the biological maturation, and school performance and verify the influence of biological maturation and school performance in motor performance of the students..

## 2 - MATERIAL AND METHODS

The research has an observational character, therefore, there is no manipulation of direct interventions on individuals under study, limiting the researcher to the observation of them and their characteristics. Still there are descriptive characteristics, having a qualitative-quantitative research profile, where in addition to quantifying the data through inferential analysis, also ranked the groups to their characteristics in the variables analyzed.

Cacoal city has a student's group of 13.621 students enrolled from elementary school through high school encompassing the public schools and private schools. From this, 8.998 students are enrolled in elementary school, and 4.623 enrolled in initial education in both school systems according to data from the State Department of Education of Rondônia (SEDUC - RO, 2010).

And the study was performed with schoolers, with the stratified probability sampling, with a universe of 4,623 students. For the selection of the sample was applied the statistical calculation of Kazmier (1982), with an error margin of 0.5%, and percentage of 8.7%, totaling to the sample of 540 students, aged 5-12 years old in the city of Cacoal / RO. Then, were applied the inclusion and exclusion criteria, thus, the sample took the total of 389 children aged 5-12 years old. To verify the sample normality, the Kolmogorov -Smirnov test was performed using SPSS, 17.0 (Marôco, 2007). After the test application samples showed behavior within normality, observing, thus, the homogeneity of the analyzed groups. To take part in the study, children should have the following inclusion criteria: Parents signing the free and informed term; Being born  in the state of Rondônia; Be duly enrolled in public and private schools in the city of Cacoal; Being aged 05-12 years old; Do not show physical, motor and neurological deficits. And children who do not fit the inclusion criteria of the study were excluded.

### 2.1 - Methods and Variables

**(a) Motor Coordination - TGMD2:** The Test Of Gross Motor Development (TGMD-2) was prepared by Ulrich (2000) and validated by Valentini et al, (2008) it is used for the collection of data on motor performance.

The test battery (TGMD-2) is a battery of tests to evaluate 12 items, six of which are locomotion skills (running, galloping, jumping with one foot, horizontal jump, jump over obstacles and side running), and six are objects control skills (batting a ball, bouncing, receiving, kick, throw over his shoulder and roll the ball under).

For the application it was used a camcorder camera for record and further analysis of the motor performance. The tests took 15-20 minutes for each application assessed. Each task performed by a child was qualitatively evaluated by performance criteria proposed by the test relative to the biomechanically execution of skills. If the child would meet certain criteria, received one point, if the child would not meet, did not receive points.

The sum of all points achieved by the child formed, according to the test protocol, the raw scores, i.e., the total points from 0 to 12 points.

According to the protocol, an inter-rater evaluation was performed, where after the recording the evaluator was analyzing and classifying each individual within the same range. After the evaluation of children, there was the second checking, and after the second checking it was applied the statistical test of Kappa to verify the consistency of the data. The test reliability can be seen in the chart below. And the strong reliability of variables can be realized: Motor ability of locomotion and motor skill control.

Chart 1 shows the reliability of the ability of locomotion and control of objects, as can be seen there was a high reliability in the two variables with the value of .996 and significance of 0,000 for locomotion and .969 with a significance level of 0.000 for control of objects.

**Table 1: KAPPA reliability test for locomotion ability and control of objects related to TGMD-2.**

| Locomotion | Rebiability | Standard Error | T | Significance |
|---|---|---|---|---|
| Average | 0,966 | 0,011 | 34,741 | 0.000* |
| N | 389 | | | |
| **Control** | | | | |
| Average | 0,969 | 0,01 | 33,686 | 0.000* |
| N | 389 | | | |

*significance

**(b) Biological Maturation:** In order to obtain data on sexual maturation (biological) were used scales of TANNER, Portuguese version, validated by (Matsudo & Matsudo, 1986). Individually, each child made a self-assessment for each of the indicators on the scale. All children received preliminary report on the use of the boards and the maturity test was applied in a separate room.

The form displays a short text that explains the development of breast characteristics, genitals and pubic hair in each maturation stage. After the preliminary explanations, the evaluated, in possession of the form, made the identification of the stage of development that most closely matches their personal image.

Tanner (1976) presents an evaluation of breast development for girls and genitals hairiness for boys, he ranked the stages as follows: I: indicates a state of pre-adolescence; II: indicates the beginning of the pubertal period; III and IV: indicate the continuity of development, or an intermediate stage; V: it indicates the final stage of development.

**(c) Educational Performance:** To check the school performance, we used the observational method, where the selected samples had their six-monthly report cards separated by the researcher who quantitatively analyzed the grades of Portuguese and Mathematics. These disciplines were chosen due to the core curriculum of schools, where they are core subjects of children's learning, where through these develop their cognitive learning standards.

**(d) Statistical treatment;** For the analysis of sample normality, we used the Kolmogorov-Smirnov test (Maroco, 2007), where the samples were found in a normal distribution for the tabulation and application of data. For characterization of the dependent variables: Total motor skills, school performance and sexual maturation. It was used descriptive statistics, where it was found the averages and standard deviation. Yet for the variables: motor skills and sexual maturation were carried out measures of central tendency and dispersion, for the variables measured on continuous scales. And the frequency and percentage for nominal and ordinal variables. Furthermore, to determine the variables that integrated the linear regression model, was initially used, the Pearson correlation test (r) to assess the association between variables. Only those that showed significant correlation entered the linear regression model in order of importance. In the interaction of dependent and independent variables a linear regression was used. For the reliability of data related to motor performance was applied Kohen Kappa index to verify the inter-observer agreement, at two different times. At first the evaluator, after filming, in possession of a form, was classifying control motor skills in scale from 1 to 6, then checked the locomotion skills on the same scale. After this process, was given a break of 6 days, and applied again the evaluation on the footage.

Finally, the current study was approved by the Ethics and Research Committee located in the School of Biomedical Sciences of Cacoal - FACIMED / RO by the Protocol 811/12.

## 3 - RESULTS AND DISCUSSION

When evaluated the overall motor skill, you can check the average score was 5.9 on where they fall below the average and a standard deviation of + - 1.2. In the variable biological maturation, sample had the score 1.9 on pubic hair in boys and 2.1 on breasts in girls, where they fall between levels 1 and 2 when checked the pubic hairiness and 2 in the breasts, that is, fitting in pre-pubertal stage both genders. When checked the chronological age of the sample, it can be seen that the average was 8.7 years and standard deviation + - 1.9 years.

When assessed school performance, through the grades, it can be seen that in the Portuguese Language subject the children achieved an average of 75 and standard deviation + - 8.34 and in Mathematics children reached the standard deviation score of 72 + - 9.76, as can be seen in the chart below:

**Chart 1: Descriptive analysis of the variables chronological age, school performance (Portuguese and math) and motor skill**

| VARIABLES | N | AVERAGE | S.D. |
|---|---|---|---|
| Chronological age (years) | 389 | 8,7* | 1,9 |
| T.M.S | 389 | 5,9 | 1,2 |
| Portugues grades | 389 | 75 | 8,34 |
| Mathematics grades | 389 | 72 | 9,76 |

T.M.S = Total Motor Skill

Chart 2 shows the absolute and relative values of the dependent variable of total motor skills on schoolers. One can see that in the very poor classification was presented 40 individuals which represents 10.28%, in the poor classification was presented 51 individuals representing 13.11%. When checked the classification below the average, it was found 198 individuals representing 50.89%.

The average classification presented 20 individuals representing 5.14%, by checking the rating above average were found 50 individuals representing 12.85%, finally, the top classification found that 30 individuals were in this rank, representing 7.71%, as can be seen in chart 2.

**Chart 2: Relative and absolute values of the dependent variable motor skill.**

| | ABSOLUTE VALUE | RELATIVE VALUE | TGMD-2 SCORES |
|---|---|---|---|
| **MOTOR SKILLS** | | % | |
| **Very poor** | 40 | 10,28 | 0 a 2 |
| **Poor** | 51 | 13,11 | 3 a 4 |
| **Below Average** | 198 | 50,89 | 5 a 6 |
| **Average** | 20 | 5,14 | 7 a 8 |
| **Above Average** | 50 | 12,85 | 9 a 10 |
| **Higher** | 30 | 7,71 | 11 a 12 |

In chart 2 it is noted, shows the frequencies and percentage values of biological maturation. And it is observed on the classification that it was more evident is the beginning of puberty where 158 children fit into this classification, which represented 40.6% of subjects, as can be seen with more specificity in the chart below:

**Chart 3: Descriptive analysis of the variable biological maturation through frequencies and percentages.**

|  | Frequency | % | Valid. % | Cumulative % |
|---|---|---|---|---|
| Prepubertal (I,II) | 117 | 30,1 | 30,1 | 30,1 |
| Beginning of puberty (III, IV) | 158 | 40,6 | 40,6 | 70,7 |
| Full puberty (V) | 114 | 29,3 | 29,3 | 100 |
| Total | 389 | 100 | 100 | |

Chart 4 shows the comparative analysis of the total motor skills within the maturational stages, it is valid to say that after applying the chi-square test it can be seen that there are differences between the total motor skills within the maturational stages with a value of 16.167 and p= 0.003.

**Chart 4: Comparison of motor skill within the maturational stages.**

| Skill Level | Very Poor | | Below Average | | Average+Above Average | | $^2$ | Sig |
|---|---|---|---|---|---|---|---|---|
| **Maturation** | Freq. | % | Freq. | % | Freq. | % | | |
| **Pre-pubertal** | 55 | 29.9% | 48 | 41,0% | 34 | 29,1% | | |
| **Beginning of puberty** | 29 | 18,40 | 73 | 46,20 | 56 | 35,40 | | |
| **Puberty** | 15 | 13,20 | 43 | 37,70 | 56 | 49,10 | | |
| **Total** | 79 | 20,30 | 164 | 42,20 | 146 | 37,50 | 16,167 | 0,003* |

*significant

Chart 4 shows the relation between the variables analyzed, which shows that the relation occurs in all analyzed variables, but the unique relation that there were significant differences between global motor coordination and biological maturation, as it can be seen in the chart below.

**Chart 5: Relation between the variables: biological maturation, total motor skill and School performance.**

| VARIABLE | N | R | P |
|---|---|---|---|
| **T.M.S x P.G** | 389 | 0,12 | 0,674 |
| **T.M.S x M.G** | 389 | 0,21 | 0,567 |
| **MATURATION x P.G** | 389 | 0,2 | 0,652 |
| **MATURATION x M.G** | 389 | 0,12 | 0,789 |

O.M.S=total motor skill, P.N=Portuguese grades, M.N=mathematics grades

Chart 5 shows the linear regression analysis between the dependent variables: Total Motor Skill and independent variables: chronological age and biological maturation. It can be seen that the two variables, age and biological maturation, explains 0.82% (p = 0.000) of the total motor skills and that the age ( = 0.237, p = 0.000) or the biological maturation (ß = 0.088 ; p = 0.000) have a significant influence.

**Chart 6: Linear regression analysis of the variables: Total motor skill, chronological age and biological maturation analyzed in the study:**

| VARIABLES | | TGMD-2 Total skill | | | |
|---|---|---|---|---|---|
| | | $T$ | $Sig$ | $r^2$ | $sig.$ |
| | | | | 0,82 | 0.000* |
| AGE | 0,237 | 4,374 | 0,004* | | |
| MATURATION | 0,088 | 1,629 | 0,104* | | |

*significant

It is noteworthy that when descriptively analyzed the data, it can be observed that some variables have an average below the cutoff point of the protocols used in the study, especially at this first moment, it presents analysis and discussion of motor skills.

Thus, it appears that on average of the TGMD2 test, the children were below the recommended (5.9), comparing with the Gallahue model, it is noted that children should be within the mature stage, specifically in the fundamental movements stage which is characterized by efficient, coordinated and controlled motricity.

For Oliveira, Magalhães and Salmela (2011), the motor and cognitive performance of children with an average chronological age of 6.2 years old, they presented mature stages of motor development. Also found that children with low weight had tendencies to have a low standard of motor development. Another study by Andrade et al., (2005), analyzed the pattern of motor development of children with an average age of 7.2 years old. Found that these children presented early stages of motor development, confirming the current study.

Castro et al., (2008), evaluated children in Rio Grande do Sul through TGMD2, found that the children presented values within the average for the most part (45%), note that in this study, the children had an average age of 6.8 years old. Compared to the current study, where the children were classified as "poor", it can be suggested that the socio-cultural influences are prevalent in this variable, since the states have significant differences in per capita income, in its colonization (the South by European immigrants) and also by the economic status of the family (Castro, 2008).

In a study performed by Corseuil et al., (2009), it was verified through TGMD2 and KTK the motor skills of schoolers with an average age of 5.6 years old in the city of Londrina in Parana. It was found that the children when compared to TGMD2 were classified as within the average. In this study, when compared children who were within the average on the same protocol they were aged 7-8 years old, thus showing that they are below the values when compared to studies. Thus, we can still justify with the hypothesis of sociocultural factors, given the geographical distribution of the research.

And comparing to the motor development theory of Gallahue (1996), at some point, in their 7 or 8 years old, children usually enter a stage of transitory motor skills (Hemgren and Persson, 2003). In the transitory period, the individual begins to combine and apply the fundamental motor skills to the performance of specialized skills in sports and recreational environments. Walking in rope bridge, jumping rope and playing ball are examples of common transitory skills. However, we must use the maturational reviews so that we can have even more conditions to analyze whether these movements ratings are in line with the state "mature" or not of the human being.

Studies on sexual maturation show that can be highlighted three fundamental difficulties: the deficiency of updated reference patterns and mostly valid, regionally; the population variability of menarche which is influenced to numerous determinants and finally the different methodologies used in each study.

In addition, it was found that the children were in the early stages of maturation, according to Tanner scales, this is reflected in their chronological age, where they were still within the second childhood. To Spironello et al., (2010) who did a study relating the biological maturation to motor competence in basketball sport in Rio Grande do Sul in the male gender. He noted that some children stood out over the others within the same age group, when compared the biological maturation of these children, it was found that the ones with more advanced maturation stages (III and IV) excel in relation to the ones in lower stages. Thus showing the importance of this variable when evaluating motor competence.

Lemos (2007) assesses the cognitive development of children in early elementary school, differentiating by gender and age. In the sutdy, it is noticed that the children with a higher scale of biological maturation also stood out cognitively, yet the girls had a higher performance when compared to boys. As the age was increasing these differences were equating.

In the relation between motor skill with the variables: biological maturation, school performance and chronological age, we saw that there was a significant relation between the variables: motor skills and chronological

age. And also motor skill and biological maturation of the schoolers. That is, this relationship is explained by the maturation of the central nervous system, where children with older ages excelled for children aged below. This does not bring news if we individually assess each individual. However, when we analyze the averages, we found that the subjects presented values lower than expected, i.e., with chronological ages not reflected in the maturational age. And the children should be on stage above the one found wich reflected in their motor skills.

Valentini (2002), analyzed the fundamental motor patterns on schoolers, through TGMD2 one of the objectives of his study was to investigate the schoolers' motor pattern (motor competence). In this study Machado and Campos found that the children were with motor competency standards below normal, with the value of 5.3 as average, at the age of 7.3, when compared to the current study we can see that these data meet the data of the current study, since in both studies children have motor competence classified as poor, being this variable analyzed by the same evaluation protocol. We can still cite some studies that have shown that children within the age group analyzed in our study had poor values in motor competence, as the studies by Valentini (2002), Villwock, Valentini (2007), Abiko et al., (2013).

As for the relationship between biological maturation and motor competence, we can mention some studies which confirm data analyzed in our study. Lopes et al., (2010) makes analysis of the relation between biological maturation and motor competence, in his study there was a strong relation r=67 between the two variables. In another study Bergman et al., (2009) found a the relation reasonable r=0.42 between the variables analyzed. For Vieira, Pinheiro and Vieira (2005), there is also a positive relation in the two variables.

Furthermore, when one extrapolates this data to the research of this scientific work, it appears that the biological factor was crucial to the quality of motor competence, that is, as children are becoming more mature, the motor "resources" continue to improve. As the children are maturationally younger, their motor patterns are poorer. There is no significant difference between genders.

## 4 – CONCLUSION

In the present study, when evaluated the variables in a descriptive way, it can be seen that in the Motor Coordination variable, students were below average in the TGMD-2 protocol proposal. Still, when compared to national studies, from different geographical points, the current study still showed itself below in motor compentence. When checked the biological variables, the maturational level was found within a normal range.

However, when checked and compared with national studies, it was found that the sample studied, was also below. It can be seen in the current study that motor skill was influenced by the factors: chronological age, biological maturation and academic perfomances in mathematics subject. Thus indicating that the intrinsic factors in this study had greater influence on schoolers' motor skills.

Thus, you must always be watching and monitoring human development, because the databases allows the construction of reliable analysis over potential delays or suspected problems attributed to human development, and more specifically to the motor development.

Finally, educators have the notion that children somehow (do not understand the mechanism), "automatically" learn how to play their fundamental movements. Many naively think that children at this stage, will develop, through the process of maturation, however, more concrete actions of educational policies aimed at physical education in elementary school are needed, to qualify physical educators and increase the number of classes to enhance the motor learning and consequently raise the cognitive development of the learners.

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* Publication Index
* Academic Journal Database
* Contemporary Research Index
* Academic Paper Databse
* Digital Journals Database
* Current Index to Scholarly Journals
* Elite Scientific Journal Archive
* Directory Of Academic Resources
* Scholar Journal Index
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