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ORIGINAL

ANALYSIS OF THE MOTOR DEVELOPMENT IN BRAZILIAN SCHOOLCHILDREN WITH CORPORAL MEASURES OF OBESITY AND OVERWEIGHT

ANÁLISIS DEL DESARROLLO MOTOR EN ESCOLARES BRASILEÑOS CON MEDIDAS CORPORALES DE OBESIDAD Y SOBREPESO

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ABSTRACT

The aim of this study was to analyse the profile of the motor features of children with overweight/obesity. The anthropometric and motor characteristics of 284 healthy children 6 to 10 years were measured, divided in three groups: with normal weight, with overweight and with obesity. The used instrument is the Scale of Motor Development EDM, developed by Rosa Neto in 1996. Obese children showed a significant deficiency ($p<0.5$) in all structures in relation to motor and chronological age. Overweight children showed a delay in equilibrium ($p<0.01$), body image ($p<0.02$), spatial organization ($p\leq0.01$) and temporal organization ($p\leq0.01$). We conclude that children with overweight and obesity are lagging behind their peers of normal weight.

KEY WORDS: motor development, obesity, overweight

RESUMEN

El objetivo de este estudio fue analizar el perfil de las características motoras de niños con sobrepeso/obesidad. Se midieron las características antropométricas y las características motoras de 284 niños sanos de 6 a 10 años, dividiéndose en tres grupos: normales, con sobrepeso y con obesidad. El instrumento utilizado es la Escala de Desarrollo Motor EDM, desarrollado por Rosa Neto en 1996. Los niños obesos mostraron una deficiencia significativa ($p\leq0,05$) en todas las estructuras motoras y en relación con su edad cronológica. Los niños con sobrepeso mostraron un retraso en el equilibrio ($p\leq0,01$), esquema corporal ($p\leq0,02$), organización espacial ($p\leq0,01$) y organización temporal ($p\leq0,01$). Se puede concluir que los niños con sobrepeso y obesidad tienen un retraso con respecto a sus compañeros de peso normal.

PALABRAS CLAVE: desarrollo motor, obesidad, sobrepeso

INTRODUCTION

Children go through continuous age-related changes (Ruiz et al., 2007). As they get older, their functional skills constantly change and improve as they acquire more experience through interaction with the environment and the tasks that they are set. Children's movement develops and improves with this interaction. At the same time, quantitative changes occur with respect to physical growth, such as increased height and weight, as well as qualitative changes such as the acquisition and improvement of motor functions.

As time passes, physical, motor, cognitive, social and emotional changes occur (Gallahue and Ozmun, 2005; Haywood and Getchell, 2004) in response to the specificity and complexity of the activities that children are set over the course of their development; these changes are by influenced by individual limitations, experiences acquired and contextual constraints, and these different restrictions may encourage or discourage children to explore movement.

In recent years, it has been observed that people in general, but especially children and adolescents, are becoming less physically active and are spending more and more time in front of the computer or watching television (Ozdirenc et al., 2005), a phenomenon that hinders development and has a direct impact on motor skills. A context characterised by lack of movement, less parental involvement with their children, consumption of a high-fat diet (Schwimmer et al., 2003) and a reduction in time spent playing outdoors in consequence of the rise in violence in large cities, together with the increasingly common phenomenon of spending more hours watching television or sitting in front of a computer, can promote obesity in young children, contributing to the transformation of childhood obesity into a global epidemic, with a negative impact on fitness levels.

In developing countries people die of hunger, while in developed countries they die from overeating. Described as a multifactorial syndrome which involves disturbances in functional abilities, biochemical composition and body structure (Kain et al., 2003; Nakandakari et al., 2000; Santos et al., 2005; Denadai and Denadai, 1998; Mantoanelli et al., 1997; Escrivão et al., 2000; Oliveira, 2002; Liz et al., 2005; Kirk et al., 2005; Fernández et al., 2004), obesity commences in childhood and presents a health risk to infants, young children and prepubescent school children. Overweight children, and especially obese children, may develop several health problems, such as diabetes and cardiovascular disease, which become worse as they enter adulthood.

Obese children show lower cardio-respiratory capacity and greater energy expenditure while carrying out activities because they have a low level of physical fitness and must thus make a greater effort to achieve the same intensity of activity; this contributes directly to poor motor development. Studies on the development of motor skills in obese children and adolescents conducted by Rosa Neto (1996) and Guedes et al. (2002) revealed impaired

development of the fundamental motor skills of locomotion and object control, as well as a greater deficit in temporal, spatial and balance organisation.

In general, obese and overweight children have poorer motor skills than expected for their age in aspects such as balance, running, sideways running, sprinting and jumping, and catching, throwing, tackling, shooting and hitting a ball. Lower levels of physical fitness eventually exclude these children from various physical activities and games, leading to inactivity (Guimarães et al., 2006). In turn, fewer opportunities for movement have a negative impact on their development, endowing them with very poor motor skills. However, the sooner appropriate intervention strategies are implemented to enhance children's performance and motivation in physical education classes, the better their chances are of improving their motor skills.

Worldwide, approximately 22 million children aged over 5 years old are overweight (NCHS, 2005). This figure is alarming, mainly because it is estimated that 80% of obese children will go on to become obese adults. There is growing concern in developed countries such as the United States, for example, where the prevalence of overweight children has doubled since the 1970s (IOTF 2002). However, the prevalence of obesity is also on the rise in developing countries: due to a change in eating habits and an increasingly sedentary lifestyle in the last 20 years, obesity in children aged between 6 and 11 years old has risen by 54%, and by 39% in adolescents aged between 12 and 17 years old. There are an estimated 5 million obese children in Brazil, with figures showing a rising trend in the future across all social classes (NCHS, 2005; WHO, 1998).

The Body Mass Index (BMI) changes with age, presenting a steady increase. Three critical periods have been identified for the onset of obesity: the first of these corresponds to the first year of life, the second one occurs between 4 and 9 years old and the third period is in adolescence (Guedes et al., 2002; Mantoanelli et al., 1997; Berkey et al., 2000). Another consequence of obesity is the result of its strong impact on the development of motor skills in children, because children with a high BMI experience difficulties performing certain movements and this can lead to disorders in fundamental skills and can interfere in various structures such as the body schema and temporal and spatial organisation. It is these motor structure disorders that characterise the deficits observed when examining motor skills in children.

Frey and Chow (2006), Janz et al. (2002) and Prista et al. (1997) have all highlighted that obese and overweight children commonly show a reduction in activity and a lack of interest in physical exercise, and that it is usually those children who are obese in early childhood (from 2 to 6 years old) that remain obese in the next phase of their development from 6 to 10 years old, to the detriment of their growth and motor development. It is estimated that 40% of school age children worldwide are obese (Reilly, 2006), and this figure shows an upward trend.

Given the above, the aim of our study was to assess the general age-related development of motor skills and compare the motor skill characteristics of overweight and obese children with those of their normal weight peers.

MATERIALS AND METHODS

Participants

The study population was composed of children of both sexes aged between 6 and 10 years old attending primary education in the provincial public education network of schools in the city of Cruz Alta in the province of Rio Grande do Sul, Brazil. This network consists of eighteen schools with a total of 4,978 children aged from 6 to10 years old. From among these eighteen public schools, eight were selected, with a total of 2679 (53.8%) children aged between 6 and 10 years old. These schools were selected because they had the highest number of schoolchildren enrolled, and consisted of three schools in the central region of the city and five in the peripheral region: schools (1) 18.3% (2) 12.3% and (3) 9.8% in the central region and schools (4) 11.2%, (5) 14.4%, (6) 8, 4%, (7) 11.2% and (8) 14.1% in the peripheral region. From these eight schools, 324 children with body characteristics suitable for the study were selected (12.9%). Of these 324 children, the parents of 284 (87.65%) gave their consent for participation in the study: 141 (49.64%) were female and 143 (50.35%) were male, 90 (31.7%) were overweight, 94 (33.15%) were obese and a total of 100 (35.21%) presented normal weight and formed the control group. Their age distribution was as follows: 55 were 6 years old (19.36%), 60 were 7 years old (21.12%), 52 were 8 years old (18.31%), 60 were 9 years old (21.12%) and 57 were 10 years old (20.09%), as shown in Table 1.

Table 1 - Total distribution of children by chronological age groups. G1 children with normal body parameters; G2 children with body parameters indicative of overweight; G3 children with body parameters indicative of obesity

	G1 Normal		G2 Overweight		G3 Obese		Total	
Age	**boys**	**girls**	**boys**	**girls**	**boys**	**girls**	**boys**	**girls**
6	9	10	9	7	9	10	28	27
7	11	10	10	10	10	10	30	30
8	8	6	8	7	9	8	27	25
9	12	12	10	10	10	10	30	30
10	10	12	10	9	8	10	28	29
Total group	50	50	47	43	46	48	143	141
Total	**100**		**90**		**94**		**284**	

Distribution in groups

The children were divided into three groups according to their BMI: (G1), 100 children with normal body parameters (the control group), consisting of 50 girls and 50 boys; (G2), 90 children with parameters indicative of overweight, consisting of 43 girls and 47 boys; and (G3), 94 children with parameters indicative of obesity, consisting of 48 girls and 46 boys.

The 284 children participating were classified and distributed according to the system for assessing nutritional status in children developed by the NCHS (National Center for Health Statistics, 2005) and the CDC (Centers for Disease Control and Prevention, 2005), and values were obtained using their BMI calculated according to the following formula: BMI = weight (in kg)/height^2 (in metres).

The NCHS uses BMI percentiles for the ages of 2 to 20 years old as follows: percentile values between 5 and 85 correspond to healthy weight children, values between 85 and 95 correspond to children with parameters indicative of overweight and values above 95 correspond to children with body parameters indicative of obesity. To assess the children's nutritional status, weight and height data were collected using a portable electronic scale (Plena MEA-08128) with a weighing capacity of 180 kg, and a height stadiometer (Cardiomed WCS) with a height capacity of up to 212 cm. To diagnose obesity, overweight and normal weight in children, their BMI was calculated taking NCHS (2005) data as the reference.

Measurement of motor development

A motor development scale was used to evaluate motor performance. This scale (the *Escala de Desarrollo Motor* - EDM) was developed by Francisco Rosa Neto (1996) at the University of Zaragoza based on other motor development tests used by classic authors such as Ozeretski, Brunet and Lezine, Berges and Lezine, Mira Stambak, Galifred-Granjon, Zazzo, Piaget and Head, and Picp and Vayer. Created to identify and diagnose movement and coordination difficulties in children aged between 2 and 11 years old, the EDM test consists of a set of 150 motor tasks that are applied according to the chronological age of each child and measures the development of general motor control of the body. Reliability of the instrument was established using the test-retest method over a four-week period in 1996, in a study of a Spanish sample of 180 children aged between 2 and 11 years old conducted to identify and diagnose children with movement and coordination difficulties. Since 1996, the scale has been used in research in the following areas: Physical Education, Physiotherapy, Education and Medicine, and has been used in several studies: Poeta and Rosa Neto (2005) and (2007), with 31 schoolchildren aged between 7 and 10 years old; Mansur and Rosa Neto, (2006), with 31 schoolchildren aged between 7 and 10 years old; Fonseca et al. (2008), with 34 schoolchildren aged between 6 and 9 years old; and Caetano et al., (2005), with 35

schoolchildren aged between 3 and 7 years old. It has also been validated by Kassandra et al. (2009) and Rosa Neto et al. (2010) in two studies with a sample of 101 Brazilian children. The motor tests comprising the scale are divided into seven areas of assessment: Fine Motor (hand-eye coordination), Gross Motor (coordination), Balance (static posture), Body Schema (imitation of posture and speed), Spatial Organisation (perception of space), Temporal Organisation (time structures, speed) and Laterality (hands, eyes and feet). As explained in the test manual, a note is made of the scores each subject obtains for each of the tasks (number of steps, height attained, number of jumps, and number of times a movement is executed). The manual provides standards for schoolchildren in yearly intervals (2 to 11 years), and two of the four tasks (jumping with one leg and lateral jumps) present the same scores for boys and girls. These scores are transformed into a motor quotient for each of the tasks, and then into a global motor quotient (Mean 100, Standard Deviation 15) and into a percentile distribution. To accomplish this, tables are used containing normative data for three populations (normal weight, overweight and obese children); thus, the resulting motor quotient is considered problematic if it is below 70 months, low if it is between 70 and 79 months, low-normal if it is between 80 and 89 months, medium-normal if it is between 90 and109 months, high-normal if it is between 110 and119 months, high if it is between 120 and 129 months, and very high if it is over 130 months.

Data analysis

The NCHS curves (National Center for Health Statistics, 2005) were used as a reference to identify the nutritional status of the children and classify them into groups. The results obtained using the EDM were used to classify motor structure performance and characterise the children's motor skills profile (problematic, low, low-normal, medium-normal, high-normal, high and very high). SPSS version 10 for Windows was used for statistical analysis of the variables of anthropometric and motor responses. The results were analysed using the mean and standard deviation of the values obtained for motor age, chronological age, weight, height, BMI and each motor skill component; the differences in structures obtained between the groups were compared for statistical determination using analysis of variance (ANOVA) with repeated measures, and differences between variables were located by means of the post-hoc Scheffe test, with a significance level of $p \leq 0.05$.

RESULTS

Fine Motor Skills: assessment and comparison of the fine motor skills exhibited by the children in the G1 and G2 groups showed that both groups performed the tasks corresponding to their age without significant differences. However, differences did appear between the G1 and G3 groups, revealing that children in the G3 group did not have the same capacity to perform the tasks as those in the G1 group, indicating impaired development of fine motor skills in the G3 group (Figure 1).

The ANOVA revealed that the main effect occurred in the comparison of fine motor skills between groups. No significant differences were found between normal and overweight children (G1 and G2, $F_{3.32} = 4.922$; $p \leq 0.027$); however, significant differences were observed between obese children and children with normal weight (G1 and G3, $F_{2.08} = 10.678$; $p \leq 0.001$). These results demonstrate that besides affecting structures that are characterised by large movements, obesity also directly affects structures requiring fine movements, which may be have an adverse impact on self-esteem (Figure 1).

When fine motor skills were compared according to chronological age in each group, only the G3 group presented significant differences ($F_{2.66} = 21.678$; $p \leq 0.002$), showing impaired motor development with respect to the chronological age of this group of children, a finding which was not observed in normal or overweight children, whose fine motor skills were appropriate for their chronological age (Figure 1).

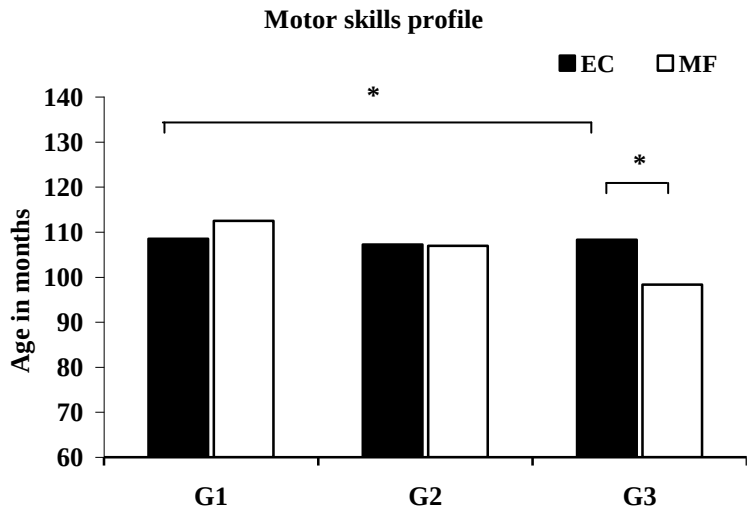

Figure 1. FMS: Fine Motor Skills, * significant differences between groups (G1 and G3) for fine motor skills, * significant differences between groups (G1, G2 and G3) for age (EC: Chronological Age) and fine motor skills (MF). Level of significance $p \leq 0.05$

Gross Motor Skills: as with the previous variable, no significant differences were observed in the gross motor skills of normal weight and overweight children ($F_{2.52} = 8.678$; $p \leq 0.032$), who performed the tasks appropriately for their ages; however, children in the G3 group were unable to perform these tasks in the same way as children in the G1 group ($F_{3.89} = 12.342$; $p \leq 0.003$), indicating that the group with obesity also presented impaired motor development in this structure (Figure 2).

When a comparison was conducted between chronological age and gross motor development in each group, no significant differences were observed between children in the G1 and G2 groups, whose motor skills profile was higher than that corresponding to their chronological age, especially in children

of normal weight, indicating that this structure was developing correctly according to their chronological age at the time of the study. However, significant differences between gross motor skills and chronological age did appear in the G3 group ($F_{1,25} = 19.325$; $p \leq 0.001$), indicating that obesity hinders movement in most of the tasks these children performed, leading to impaired development of the gross motor structure (Figure 2).

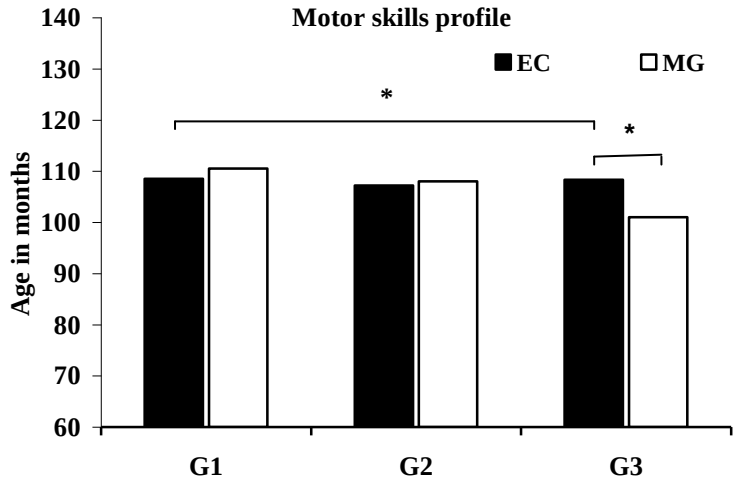

Figure 2. GM: Gross Motor Skills. * significant differences between groups (G1 and G3) for gross motor skills, * significant differences between groups (G1, G2 and G3) for age (EC: Chronological Age) and gross motor skills (MG).

Balance: when a comparison of mean values obtained for this structure was conducted between groups, the G1 group was observed to perform significantly better than the other two (G1 and G2, $F_{1.52} = 22.478$; $p \leq 0.001$; G1 and G3, $F_{3.89} = 17.342$; $p \leq 0.002$), and the mean score obtained for the G3 group was lower than that of the G2 score (Figure 3). These results indicate that balance, which controls posture during the execution of a given task, is directly affected by obesity and overweight.

Regarding the relationship between chronological age and development of the balance structure, significant differences at the $p \leq 0.005$ level were observed in the G2 and G3 groups (G2, $F_{2.32} = 10.329$, $p \leq 0.002$; G3, $F_{1.25} = 19.325$; $p \leq 0.001$), but not in the G1 group ($F_{3.22} = 11.521$; $p \leq 0.021$) (Figure 3), demonstrating a deficit in the development of balance with respect to chronological age in these two groups.

Body Schema: the results for this variable showed that children in the G1 group performed significantly better than those in the G2 and G3 groups (G1 and G2, $F_{2.45} = 18.614$; $p \leq 0.001$; G1 and G3, $F_{1.89} = 16.235$; $p \leq 0.003$). It was also observed that the mean scores for children in the G3 group were lower than those obtained for the G2 group (Figure 4), demonstrating the direct effect of obesity and overweight on the body schema. Regarding the relationship between chronological age and body schema, no significant difference was found for the G1 group ($F_{2.22} = 6.487$; $p \leq 0.011$), but significant differences did

appear in the case of the G2 and G3 groups at the p≤ 0.005 level (G2 , $F_{3,08}$ = 1.587 ; p≤ 0.005; G3, $F_{3.55}$ = 21,235; p≤ 0.001), who generally presented a higher chronological age, thus indicating a deficit in the two groups characterised by a higher BMI (Figure 4).

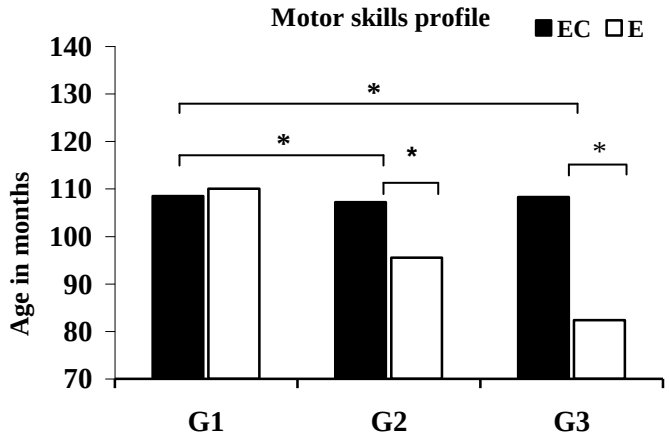

Figure 3. B: Balance. * Significant differences between groups (G1 and G2) for balance, * significant differences between groups (G1 and G3) for balance, * significant differences between groups (G1, G2 and G3) for age (EC: Chronological Age) and balance (E).

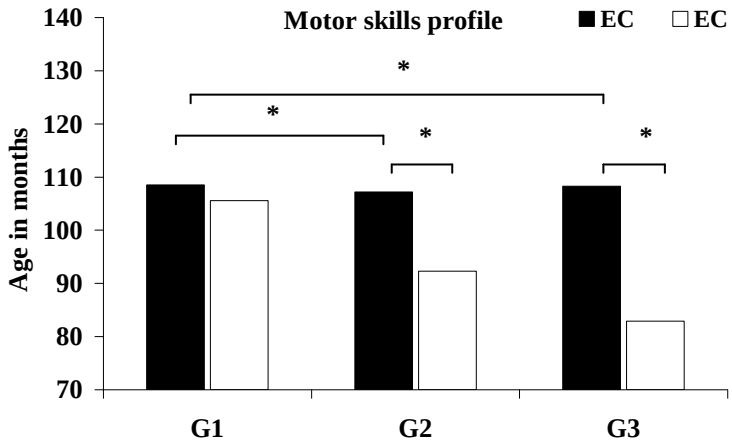

Figure 4. BS: Body Schema. * Significant differences between groups (G1 and G2) for the body schema variable, * significant differences between groups (G1 and G3) for body schema, * significant differences between groups (G1, G2 and G3) for age (EC: Chronological Age) and body schema performance (white EC).

Temporal Organisation: as with the above variables, the G1 group once again performed significantly better than the other two groups, which presented clearly inferior motor skills, with large differences between the mean values; the

mean scores for children in the G3 group were lower than those for the G2 group (Figure 6). ANOVA revealed a main effect in the comparison of the G1 and G2 groups, with $F_{1.8} = 9.369$; $p \leq 0.001$, with statistically significant results. Likewise, when comparing the G1 and G3 groups, the ANOVA results showed a $F_{1.4} = 6.235$; $p \leq 0.002$, and these results were also statistically significant. These data indicate that this variable is significantly affected by obesity and overweight (Figure 6).

As regards the comparison between chronological age and temporal organisation in each group, the ANOVA detected significant differences in all three groups: the G1 group obtained $F_{1.4} = 6.325$; $p \leq 0.001$; the G2 group obtained $F_{1.4} = 12.688$; $p \leq 0.001$ and the G3 group obtained $F_{1.8} = 17.661$; $p \leq 0.004$. All groups presented a lower score than that corresponding to their chronological age, although this result was less pronounced in the normal weight group (Figure 6).

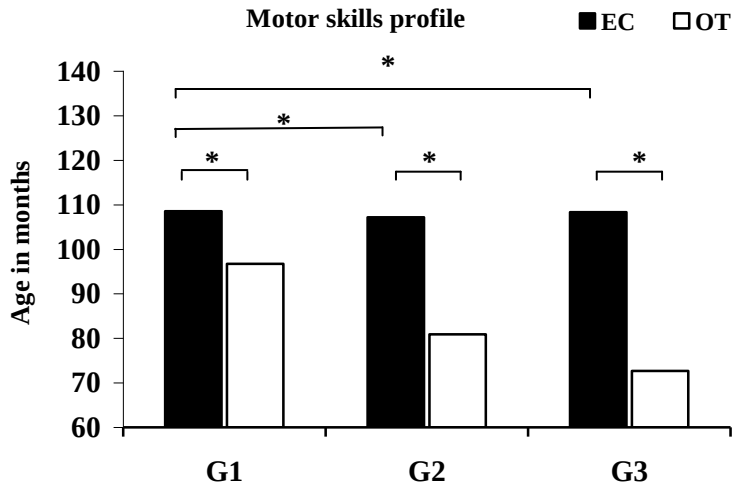

Figure 6. TO: Temporal Organisation. * significant differences between groups (G1 and G2) for temporal organisation, * significant differences between groups (G1 and G3) for temporal organisation, * significant differences between groups (G1, G2 and G3) for age (EC: Chronological Age) and temporal organisation (OT).

DISCUSSION

This study presents the objectively measured differences in and characteristics of motor performance in overweight and obese children aged six to ten years old compared with their normal weight peers. There is little scientific information about objectively measured motor skills profiles in children. To date, few studies have analysed the performance of motor skill structures (fine motor skills, gross motor skills, balance, spatial organisation, temporal organisation, body schema and laterality) in schoolchildren. These data are necessary to understand motor behaviour in children and to implement more effective intervention programmes.

The results obtained in this study are revealing, since the structures assessed differed significantly between the groups, with the obese group showing the lowest mean scores for the motor skill variables analysed. However, the overweight group also presented differences compared with the normal weight group as regards the mean scores obtained for the variables of balance, body schema and spatial and temporal organisation.

These data clearly indicate that children with parameters indicative of obesity and overweight experienced difficulty in performing most of the motor skills activities, and the effects were more visible in those structures where the children had to perform large movements which demanded complete coordination of the body. In this case, the structural variables most affected were balance, body schema, spatial organisation and temporal organisation. Andersson et al. (2002), Bohme (1998), Damaso (1994), Gallahue and Ozmun (2005), Thompson (2000) and Rosa Neto (2002) have all demonstrated in their studies that a lack of balance has a substantial impact on other motor skill variables. Another aspect which has been observed is that children who do not have good balance and experience difficulties with coordination often lack confidence; from a psychomotor point of view, they are unstable, constantly changing position in an attempt to stabilise their balance, and this may have an adverse effect on their affective capacity since besides exerting a negative effect on motor development as a whole, inadequate balance can also have a negative impact on affective and cognitive development.

Rosa Neto (2002), Damaso (1994), Gallahue and Ozmun (2005) and Pellegrini et al. (2003) have reported that children with impaired balance often claim that they do not like physical activity, due to their poor performance in these activities, and as a result they are eventually socially excluded. According to these authors, not only has it been shown that balance is an extremely important motor structure for adequate motor development in children, but also that it is through balance that children establish a sense of self-esteem (it supports and prepares them for the other structures). The individual characteristic obtained in this study for each group as regards their mean motor skill performance can be compared with the work reported by Rosa Neto (1996, 2002), in which assessments were conducted of Spanish children presenting various motor problems. In both studies, this author found that the movements of normal weight children were more efficient than those of children who were overweight, obese or malnourished.

Studies by Andersson et al. (2002) indicate that about 25% of balance can be explained on the basis of variables of a morphological nature. It should be emphasised that the rate of progression of motor development varies according to the individual stimuli, experiences and characteristics of each child (according to Gallahue and Ozmun, 2005; and Gallahue, 1995). Children in the G2 and G3 groups presented a higher body weight than expected for their height and age, and the development of their motor skills seems to have been affected as a consequence, with a deficit in motor development in obese and overweight children. Obesity is one of the most influential of the variables that

can lead to significant deficits in motor development; studies such as those by Ruiz et al. (1997), Thompson (2000), Lazzoli et al. (1998), Schwimmer et al. (2003), Ozdirenc et al. (2005), Dâmaso et al. (2001) and Hancox and Poulton (2006), have emphasised the importance of detecting possible motor impairment in children who present difficulties in their fundamental motor skills, and of implementing the necessary interventions in the variables most affected.

Berleze et al. (2007) studied obesity and motor skill development in 424 children aged between 6 and 8 years old from different social groups, and observed deficits in obese children in all structures and better motor skills in boys than in girls.

Causgrove (2002) and Gallahue (1995) have postulated that an individual's command of motor skills is directly associated with the constraints imposed by the cultural group to which that person belongs, a notion supported by the results of a study by Silva et al. (2005) evaluating the influence of socioeconomic and cultural factors on the development of motor skills in children. The study showed that schoolchildren in rural areas presented better motor skills profiles than schoolchildren from urban areas: clearly, schoolchildren in rural areas are more active and have more opportunities and space for physical activity. In order for their motor skills to develop adequately, it is essential for children to use all the spaces available for leisure and physical activities, such as streets and parks (Beurden et al., 1992; Basso and Marques, 1999). Restrictions on space in urban areas can impede children's participation in activities involving gross motor skills. It should be emphasised that when encouraging obese children to practice their motor skills, other safe and appropriate spaces for such acttivity should be assessed. Ruiz et al. (1997), Ruiz (1995), Fedre et al. (2005), Negrine (1995) and Thompson (2000) have stated that impaired neuro-psychomotor development (NPMD) can occur as a result of reduced motor activity and lack of interest in physical exercise, characteristics more commonly found in obese children (Garcia and Fernandez, 1996).

It seems that there is a clear need to emphasise motor skills in children's developmental process, as these help build children's cognitive abilities in response to environmental stimuli, and these stimuli, in turn, only acquire meaning as children's motor development provides the necessary conditions.

The schoolchildren with poor motor skills, as demonstrated in the G2 and G3 groups, presented higher levels of passivity than their peers in the G1 group. This was observed during execution of the tests, where schoolchildren in the G3 group showed a distinct lack of interest in carrying out the tasks they were set and required encouragement to do them; they also showed a lack of perseverance, a lack of confidence in their level of skill, a lack of organisation in performing movement sequences, timidity and caution when attempting the tasks, a lack of enjoyment and a fear of failure, aspects which were also crucial in their low motor skill performance levels.

The results of this study are consistent with those reported in studies by Feder et al. (2005), Ozdirenc et al. (2005), Saxena et al. (2004), Tremblay and Willms (2003), the American Academy of Paediatrics (2004), Kain et al. (2003) and Flores et al. (2005), all of which have expressed increasing concern about the poor fitness levels of obese children when compared with those of normal weight children. It should also be emphasised that obesity may be contributing to the low levels achieved by the children studied, as the results were low when compared with normal weight children. As regards the motor skills performance of obese and overweight children, the results of the present study strongly suggest that obesity exerts a negative influence on the process and the product of the performance of fundamental motor skills, with the children who were obese being those most affected, presenting deficits in motor performance regardless of age.

This point is directly connected to our final observation, namely the importance of incorporating this type of result in the initial training of future physical education teachers. It is very important to understand the thoughts, cognitions and limitations of schoolchildren and to analyse their individual bodily differences, and even more so in terms of gender. Addressing diversity involves analysing all of its components and limitations, and among these, those related to motivation are of paramount importance. This can help endow teachers with self-awareness concerning their origins and their social and cultural prejudices, and at the same time enable them to understand that tolerance and flexibility in the face of differences related to gender, ethnicity or culture should be a standard for behaviour in the classroom, employing learning and motivation scenarios that favour children's performance and command.

CONCLUSIONS

Through an analysis of the results obtained in the study, and in accordance with the objectives proposed, we arrived at the following conclusion: the obese and overweight children studied using the EDM scale demonstrated a motor skills profile classified as lower and much lower, respectively, than that of the group of normal weight children.

When performance of each motor skill variable was compared, significant differences in the six psychomotor variables were observed between groups. A greater deficit in the development of motor skills was identified in the following specific structures: balance, temporal organisation, spatial organisation and body schema, aspects which can be attributed to obesity and overweight.

As for the comparison of chronological age and general age-related motor skills, we found that the ages most affected by overweight and obesity were ages six to seven, seven to eight, and nine to ten years old, as it was these age groups which obtained statistically significant results, with a mean score for general age-related motor skills that was significantly below chronological age.

This poor motor performance is explained by body weight and lack of activity, followed by the lack of adequate motivation among this population that is increasingly present in physical education classes.

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