THE INFLUENCE OF THE VARIABLES FAT MASS PERCENTAGE, EK FUNCTIONAL MOTOR SCALE AND AGE IN CHILDREN WITH DUCHENNE MUSCULAR DYSTROPHY.

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ABSTRACT

Objective: the purpose of this specific study is to determine the influence of the fat mass percentage and age on the mobility of these individuals, evaluated by the EK scale. **Materials and Methods:** the skinfolds measures were used to evaluated and anthropometric formulas were used to calculate fat mass percentage, as well as calculated age means. The EK scale was also applied, by a total of five evaluations in six people. **Results:** all values demonstrated that, as the age value gets higher, the fat mass and EK scale points were higher either, meaning that these individuals have bigger motor limitations. **Conclusions:** After the application of the Rho Spearman test the correlations values between the variables of fat mass

and EK scale, the correlations results showed “Very Good” values, meaning that one gets higher as the other one gets higher too, with a 0,006 significant statistical value, and was also obtained “Very Good” correlation results between age and EK scale (0,000).

Key-words: Age; Fat Mass Percentage; EK Motor Functional Scale; Duchenne Muscular Dystrophy.

INTRODUCTION

The Duchenne Muscular Dystrophy is a genetic disease and its main characteristic is the muscle weakness and progressive atrophy of these ones. This fact comes from the absence of the distrophyne protein production, which brings implications to the normal functionality of the muscles.

The DMD is the most common and severe dystrophy within an incidence of 1 to 3500 male bourns that leads to a physical disability by muscular weakness. The first symptoms are the volume increase of geminal muscles, frequent falls and the difficulty in climbing stairs. It’s caused by a defective gene that suffers a genetic mutation, in the short arm of the X chromosome, more exactly in the xp21 region. A women has got two X chromosomes and men have only got one, meaning that, if a woman has one defective X chromosome, the other one will protect her from developing this disease. That’s why only male gender is affected. In 65% of these cases, when the mother is a gene carrier, we have 50% chances that her child will be affected. However, when the mother isn’t a gene carrier, there’s also a 35% possibilities that the children will born with the disease, and when that happens it’s called a new mutation or punctual mutation.

The most common symptoms are progressive muscle weakness, frequent falls, daily difficulties like climbing stairs, frequent stages of quick fatigue, lost of intellectual ability, scoliosis and muscles deformities.

According to Zanardil and all (2002) º, there is an increasing obesity tendency in these individuals by movement limitations, so that we proceeded to the BMI evaluation and fat mass measures, which influences the mobility degree in daily activities of our study individuals that we classify in the EK motor functional scale. This scale submits a certain value to each individual that quantifies a lower or bigger limitation in their abilities. As higher the scale value is, the bigger will their motor limitations be.

MATERIALS AND METHODS

Participants and data collection

Our sample was a group of six individuals, all of them of male gender with ages between seven and eleven years old. All individuals were submitted to five evaluations where the variables analysed were the age, fat mass percentage and EK functional motor scale.

Anthropometric measures

In order to evaluate the fat mass percentage, we applied the anthropometric techniques of skinfold measures described by Vieira and Fragoso (2005)[1]. For this purpose we used a skinfold plastic instrument with digital reading that provides more precision. Afterwards, we measured this skinfolds we calculated the fat mass percentages taking in consideration the body composition protocols that are used to evaluate children from six to seventeen years of age. We must have in consideration certain values regarding if the children are white or black.

The formula used on this protocol to calculate the fat mass percentage only measures two skinfolds, the triceps and the scapular skinfolds. The equation to determine this variable is the one we present next:

$$\% FM = 1{,}35 (TR + SB) - 0{,}012 (TR + SB)^2 - C$$ (C = constant, see table 1).

Table 1 – Constant values by age, gender and race from Lohman (1986), Pires and Petroski (1996).

Sex/Race	**Ages**											
	6	7	8	9	10	11	12	13	14	15	16	17
Male												
White	3,1	3,4	3,7	4,1	4,4	4,7	5,0	5,4	5,7	6,1	6,4	6,7
Black	3,7	4,0	4,3	4,7	5,0	5,3	5,6	6,0	6,3	6,7	7,0	7,3
Female												
White	1,2	1,4	1,7	2,0	2,4	2,7	3,0	3,4	3,6	3,8	4,0	4,4
Black	1,4	1,7	2,0	2,3	2,6	3,0	3,3	3,6	3,9	4,1	4,4	4,7

EK Functional Motor Scale

The EK functional motor scale is also an instrument of evaluation and by this one we can quantify the functional limitation degree of each individual. This scale presents a group of ten questions and each question has three items, and makes a maximal total of thirty points. This means that the higher the total of points is, the bigger will the limitation of the individual be.

Statistical Analysis

The values acquired were exported to computing applications. The statistical treatment of the data was in charge of the SPSS 17 program (Statistical Program for Social Sciences), with a significance level of 0,05, using the non-parametric tests of Kruskal-Wallis and Mann-Whitney “U” test. The descriptive analysis (means and station deviations) was calculated to all variables, on every evaluation. We also applied the Rho Spearman test to verify the type of correlations between variables and analyse the statistical relevance.

RESULTS

In the tables below we present the established data from the evaluations that take place with the individuals that constitute the study sample, regarding the values of age, fat mass percentage and EK scale.

Table 2 – Values obtained from the five evaluations regarding each and every one of the individuals.

Individual	Evaluation	Age	% FM	EK
1	1	7	16.09	3
	2	7	16,40	5
	3	8	16.72	6
	4	8	17,31	8
	5	9	17.91	10
2	1	7	18.89	3
	2	7	19,48	6
	3	8	20.8	8
	4	8	21.04	10
	5	9	22	12
3	1	6	17.68	2
	2	6	18,49	3
	3	7	19.30	4
	4	7	20,08	6
	5	8	22.3	7
4	1	8	18.5	9
	2	8	18,95	10
	3	9	19.4	11
	4	9	23.3	14
	5	10	25.1	17

5	1	9	20.22	9
	2	10	21,51	12
	3	10	24,10	15
	4	11	25.4	18
	5	11	27.4	21
6	1	9	21.93	8
	2	10	22,26	11
	3	10	22.6	14
	4	11	23,43	16
	5	11	24.8	20

The table 2 indicates that all individuals increase their fat mass percentage and EK scale from the first to the fifth evaluation, as the age values get higher. The individuals one, two, three and four, present in the beginning of this study normal fat percentage. In the end of all evaluations each of these individuals presents high levels of fat mass percentages.

Table 3 – General mean values of all samples, regarding the age, fat mass percentage and EK scale variables.

Group		**Age Mean**	**FM Mean**	**EK Mean**
Evaluated group	Mean	9.33	20,5247	9,93333
	N	6	6	6
	Std Deviation	1,89	2,23905	4,56596

Table 3 presents the variables means values of Age, %FM and EK. The %FM is considered “High moderated”, Pires and Petroski (1996)[3] and EK scale is considered a lower value, because it is diminished by the younger individuals.

DISCUSSION

After the analysis of the correlations between variables, presented in tables 4 and 5, we find that as age gets higher, fat mass and EK scale values are as well higher. All variables increase from de first to the fifth evaluation, which also increase the EK scale values, meaning that there are more motor limitations by these individuals. We can see in table 4 that fat mass percentage presents significant statistical references regarding the EK scale. We can find that the correlation factor between EK scale and BMI variables becomes a positive association, though lower and less relevant, and doesn’t have a significant statistical value (0.229), meaning a very humble interference in functional mobility.

Table 4 – Correlation values between EK scale and Fat Mass variables.

Test	**Mean and Coefficient**		**EK mean**	**FM mean**
Rho Spearman's	EK mean	Correlation Coefficient	1,000	0, 901
		Significance	.	0, 006
		N	6	6
	FM mean	Correlation Coefficient	0, 901	1,000
		Significance	0, 006	.
		N	6	6

We can find that the correlation factor between EK scale and Fat Mass variables becomes very high in statistical terms (0,006). This represents a very positive association "Very good", between 0,90 and 1. It's the second most influent value into EK scale.

As far as we know, obesity leads to a bigger muscular erosion and stresses a higher skeletal deformity. Our study sample presents distinct fat mass values, knowing that a bigger percentage of that same mass has a derivation of bigger limitations in EK scale. A higher weight makes them more dependent and alters their body composition decreasing the thin mass which, at the same time, degenerates with the disease progression. Our fat mass percentages (20,52%) are inferior once compared to Zanardi et all. (2002) which are of 32%, and our age means they are also inferior when compared with Mok (2006) that is 10,4% .

Table 5 – Correlation values between EK scale and Age variables.

Test	**Mean and Coefficient**		**EK Mean**	**Age Mean**
Rho Spearman's	EK mean	Correlation Coefficient	1,000	0, 982
		Significance	.	0, 000
		N	6	6
	Age mean	Correlation Coefficient	0, 982	1,000
		Significance	0, 000	
		N	6	6

We found that the correlation factor between EK scale and Age variables is the highest one of all (0,000). This represents a “very good” and positive association between the variables between 0, 90 e 1. It’s the most influent value in the EK scale.

After analyzing all the tables, we found that Fat Mass and Age variables are the most influent ones in the EK scale values. However, the age factor is not reversible and by the time these individuals grow older they are gradually increasing their functional limitations. We verified the same situation in Ramacciotti and Nascimento (2009) where the individual, with six years didn’t have significant limitations, was able to walk and capable of doing several activities with a little help. On the other hand, fat mass percentage can be controlled and attenuated with a guided diet and a very moderated exercise practice, considering the mobility capacity of each person.

As the age factor increases, their moving abilities will be bigger, meaning higher EK scale values. We are able to verify that the facts in table 6 where the correlation value is higher is significant. Younger children that can fulfil several tasks by themselves are the ones that have lower EK scale values. Okama (2010). Willing (1997) have made a brief evaluation on their eight patients with DMD with ages between nine and twelve years old and an age mean of 11,1 years old. The fat mass percentage mean was 11.4%. This value indicates that these individuals were not obese, with a lower value regarding our study. We also comply with the study of Okama (2010) where the older individuals are more dependent in their daily activities. The major benefit of EK scale is that it can be applied in any stage of this disease, because it is practical, non-invasive and doesn’t cause any kind of pain or discomfort to the patient. By this, it becomes a useful tool, to intervene in a earlier stage of this condition and to try to permit, at least, a more tranquilizing quality of life.

REFERENCES

1. ACSM (2001). Resource Manual for Guidelines for Exercise Testing and Prescription. Exercise and Sport Sciences Editorial Service. Baltimore MD, USA;
2. ABREU, SUSANA (1999). Distrofia Muscular de Duchenne – Do Gene à Reabilitação, Vol. 6, n.º 21, pág. 27 a 43. Arquivos de Fisiatria, Hospital Pediátrico – Coimbra;
3. APN (2007). "A (d)eficiência no acompanhamento dos Doentes Neuromusculares – da expressão dos doentes e famílias à construção das respostas sociais". Revista 47 – Debate Aberto, Porto;
4. BRITO, RÔMULO E COL. (2010). Treinamento muscular respiratório em pacientes portadores de distrofia muscular de Duchenne no ambiente aquático. UNESC, Brasil;
5. CAROMANO, FÁTIMA (1998). Efeitos Fisiológicos de Sessão de Hidroterapia em Crianças Portadoras de Distrofia Muscular de Duchenne. Revista Fisioterapia U.S.P, vol 5, n.1, p. 49-55: São Paulo, Brasil;
6. CAROMANO, FÁTIMA (2004). Revisão e actualização da graduação da resistência ao movimento durante a imersão da água. Revista Fisioterapia. USP, vol. 5 - nº 11: São Paulo, Brasil;
7. CAROMANO, FÁTIMA E COL. (2010). Correlação entre a massa de gordura corporal, força muscular, pressões respiratórias máximas e função na Distrofia Muscular de Duchenne. Revista Conscientiae, vol. 9, n.º 10, São Paulo, Brasil;
8. CAROMANO, F. A. (1999). Charateristics of the Duchenne's muscular dystrophy (DMD) patient. A review Arq. Sciences Unipar. Jaguaré, SP: Brazil;
9. DOWNIE, P. (1997). Neurologia para fisioterapeutas. Medicina Panamericana Editora do Brasil: pág. 403 a 423: São Paulo, Brasil;
10. DUBOWITZ, V. (1989). A color atlas of muscle disorders in childhood. Wolfe Medical Publication, London, England;
11. EMERY, ALAN (2000). The muscular distrophies. The Lancet, Vol 359. London, UK;
12. ESSEX, CHARLES. (2001). Late diagnosis of Duchenne's muscular dystrophy presenting as global developmental delay. BJM Clinical Review, Vol. 323, Birmingham, UK;

13. FABRIS, SANDRA (2005). Distrofia Muscular de Duchenne: Aspectos clínicos relevantes para a intervenção terapêutica. Edições Medicina e Saúde, São José de Rio Preto, São Paulo – Brasil;

14. FILHO, JOSÉ; REIS, VITOR (2006). Manual de Antropometria. Edições e Serviços Gráficos UTAD, Vila Real de Trás-os-Montes;

15. LEDOUX, PATRICK (1995). Kinésithérapie de L'enfant paralysé – Spina bífida, amuotrophies spinales infantiles, myopathie de Duchenne de Boulogne. Illustration de Collection de Kinésithérapie Pédiatrique: Paris-France;

16. LOHMAN, T.G.; PIRES, NETO E PETROSKI, HENRY (1986). Applicability of body composition techniques and constants for children and youth. Exercise and Sports Science Review, 14, 325-357. University of Arizona, USA;

17. MARQUES, M.J. (2007). O esforço da ciência para decifrar a distrofia muscular de duchenne. Jornal da Unicam, Universidade Estadual de Campinas, SP-Brasil;

18. MARTINEZ, JOSÉ E COL. (2006). Validação da Escala Motora Funcional EK para a Língua Portuguesa. Revista da Associação Médica Brasileira, 52 (5): 347-51: USP, Ribeirão Preto, São Paulo;

19. MOK, ELISE E COL. (2006). Estimating body composition in children with Duchenne muscular dystrophy : comparison of bioelectrical impedance analysis and skinfold-thickness measurement. The American Journal of Clinical Nutrition, vol. 83, n^{o}1, article 27, pp. 65-69: Rockville Pike, Bethesda, USA;

20. NAIR, SIVARAMAN (2001). Disabilities in Children with Duchenne Muscular Dystrophy: A Profile. Journal of Rehabilition Medicine; 33: 147–149, Uppsala-Sewden;

21. OKAMA, LARISSA E COL. (2010). Avaliação funcional e postural nas distrofias musculares de Duchenne e Becker. ConScientiae Saúde, vol. 9, n-º 4, pág. 649-658. Ribeirão Preto, São Paulo, Brasil;

22. OVANDO, ANGÉLICA (2008). A hidroterapia como forma de tratamento para Distrofia Muscular de Duchenne: relato de caso. Revista Efdeportes, Ano 13, n.º 126, Buenos Aires-Argentina;

23. PIRES, NETO E PETROSKI, E. (1996). Desenvolvimento e validação de equações generalizadas para estimativa da densidade corporal. Universidade Federal Santa Maria, Rio Grande do Sul, Brasil;

24. POLLOCK, M.L.; SCHMIDT, D.H. & JACKSON, A.S. (1980). Measurement of the cardiorespiratory fitness and body composition in the clinical setting. Compr. Ther.,6, 12-27. Long Island, USA;

25. RAMACCIOTTI, EDUARDO E NASCIMENTO, CARLA (2009). Efeito do exercício resistido na função motora do paciente com Distrofia Muscular de Duchenne. Revista neurociência 18 (3): 341-346, Salvador – Brasil;

26. SILVA, ANTÓNIO; REIS, VICTOR; FILHO, JOSÉ; FERNANDES, PAULA (2006). Manual de Antropometria. UTAD-Serviço Editorial, Vila Real;

27. SALES, I. E COL. (2004). Efeitos de exercícios físicos em piscina sobre a função pulmonar do portador de distrofia muscular de duchenne. Um relato de caso. Arq. Ciênc. Saúde Unipar, Umuarama, 8 (1), Jan./Abr. pág. 67-72, Maringá, Brasil;

28. SWAN-GUERRERO, SHEILA (2007). Potential Benefits of Exercise. College of Applied health sciences- department of disability and human development. UIC, Chicago, USA;

29. WILLIG, LEROY (1997). Body composition determinated with MR in patients with Duchenne muscular dystrophy, spinal muscular atrophy, and normal subjects. Elsevier, vol. 15, n.º 7, pp 737-744, USA;

30. ZANARDIL E COL (2002). Body composition and energy expenditure in Duchenne muscular dystrophy. University Research Centre, Pavia – Italy;

31. ZITELLI, B. E DAVIS, H. (1992). Atlas Colorido de Diagnóstico Clínico em Pediatria. Editora Manole, 2ª edição: São Paulo, Brasil.