148 - MEASUREMENTS METHODS OF CORPORAL FAT IN CHILDREN

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INTRODUCTION

Nowadays, many non-contagious diseases make part of our everyday, taking the man, in these new times, more subjects to these problems that sweep the countries in development as far as the development countries in all continents.

It can be said that a great deal of these diseases is connected to changes in human body composition, which is changing increasingly accelerated and precocious, and it is directly associated to sedentary life style and the technological facilities more and more present nowadays.

The obesity has emerged as the most common pediatric illness in western countries. The prevalence of childish obesity is North America is about 10% to 25% and it is increasing rapidly in the course of the last two decades (FLEGAL 1999).

In Brazil, it is checked a process of nutritional transition in the last decades. By comparing the data of National Study of the Familiar Expense (NSFE), realized in 1974/1975, with the data of research about Standards of Life, realized in 1996/1997, only in South-East and North-East it was checked a raise in prevalence of overweight and obesity about 4,1% to 13,9% in children and adolescents with ages between 6-18yeats (WANG *et al* 2002).

Studies realized in some Brazilian's cities show that overweight and obesity already attain more than 20% of children and adolescents, as in Recife, reaching 35% of the evaluated students (BALABAN and SILVA, 2001).

To measure and to evaluate the body composition of the individuals is important to verify if they have percentage levels of body fat and lean corporal mass in levels considered healthful, because diverse studies confirm that exist relation between morbidity, cardiovascular illness and diabetes type 2 (PAFFENBARGER *et al*. 1986 and 1996).

There are many methods developed to the estimate of body composition, suchlike anthropometry, electric impedance, underwater weighing, and radiographic methods (HEYWARD *et al* 2001).

However, independently of the selected method to evaluate the body composition, every indirect method has some kind of limitation and mistakes that have to be controlled and standardized. Therefore, every indirect method has to be validated specifically to the target population which will be used for such method, because many times the populations are different from each other, and the wholesale use of any method to measure the percentage of fat can produce values that are nor trusty for the measure in discussion (TOTHILL el al 1996)

The anthropometric method actually is the most used for measure the fat percentage (HEYWARD et. al. 2001), due to its facility of application in big populations, low price of equipment and not much invasive. Otherwise, dual-energy X-ray absorptiometry (DXA), despite its high cost, is being used very much as standard method for estimate of the corporal fat, including as criterion for validity of others methods (ROCHE et. al. (1996) and LOCK NER, HEYWARD, BAUMGARTNER & JENKINS (2000)).

Hence, this study has the objective to analyze the results found by two measure methods of fat percentage in children with 10-12-year-old of one public school in Brasilia.

MATERIAL AND METHODS

The sample was composed by 21 children of 10-12years, average of age = (11,050,38), stature's average = (146,028,04) and body mass average = (37,098,08).

All the components of the study were students from the fifth grade of one public school from Brasilia DF, where they had a free and clear consent form signed by theirs parents. The Committee of Ethics and Research of the University Catholic of Brasilia approved the study and it was realized inside the university.

Students who hadn't had written authorization, age between 10-12 years and were feminine sex were excluded from the study.

Only one assessor realized all the anthropometrics measures, conducted and analyzed the results put out in the machine of dual-energy X-ray absorptiometry.

Corporal mass was measured on a digital weighing-machine of Filizola brand, with one resolution of 0,1Kg. For this measurement, the individuals wore the less number of clothes as possible, placed themselves on foot and finally stood immovable until the stabilization of the value presented on the viewer of the related weighing-machine. The volunteers were put on back to the balance's viewer so that they do not look the results and do not lean, what can vary the numbers on the viewer.

The stature was evaluated with the stadiometer that stay behind the same balance used to measure the corporal mass. For this procedure, the students joined feet and touched the heels in stadiometer, stayed erect with the arms relaxed along the body. The evaluated one's head was positioned in a way that the face stayed in vertical. Another reference used for head position included the placing of Frankfurt's plan, where the imaginary line that goes through the lowest point of the inferior brim from right. (MARINS & GIANNICHI, 1998). After these adjustments, the metal arm of the stadiometer was placed over the most prominent point of head, in which the stadiometer was waged for reading realization.

For the measurements of corporal fat by DXA, it was asked to the volunteers to take off any metal's objects they could carry, as alliance or jewels in general, belts, watches and others (because those objects modify the values of evaluates variables by DXA). Next, volunteer was placed lying down in dorsal decubitus over the DXA machine to analysis of the whole body.

It was selected the option pf pediatric analysis with average velocity and all maker's recommendations were followed. The apparatus used for DXA was from Lunar band, DPX-1Q model, and “software” 4.6A. In this apparatus, the mineral osseous content, the quantity of muscular mass, the quantity of fat mass per follow-up and the corporal total fat measured in relative terms (percentage of fat) and absolutes (Kg per body region) were estimated, despite only the results regarding to bodily fat be used for this study. Before using, DXA apparatus was duly calibrated, according the maker's recommendations and adjustments of the pre-determined cut lines, for the analysis by DXA, were made always by the same appraiser.

The measure of the skinfold thickness were realized three times by the same experienced appraiser technique, making use of an Lange skinfold caliper brand in the localizations of triceps, subscapular and calf.

For estimate of bodily fat, two equations, developed by SLAUGHER in 1988, were used: the first one utilizes the triceps and the subscapular skinfold (%GC= 0,783 x (doc) + 1,6), and second: triceps and the calf skinfold (%GC= 0,735 x (doc) + 1,0) and its was called PROT. 1 and PROT. 2.

STATISTICAL ANALYSES

The inferential described statistics was used to determinate the relation of relative corporal fat determined through the hydrostatic weighing and DXA.

The suggestions of LOHMAN (1992) were followed for the analysis of validation, through coefficient calculations of Person's linear correlations (r), the most common method used to calculate the correlation between two variables, paired t test or (t) dependent to verify the differences between relative corporal fat measured and relative corporal fat estimated, constant error, total error and model error of estimation which is read as a computation of the pattern-bias of all the residual scores from one population, in other words, the due error marg- in one prediction, in which:

Gm = gordura corporal relativa mensurada

Ge = gordura corporal relativa estimada

$$EPE = s\sqrt{1-R^2}$$

$$ET = \sqrt{\sum (Ge-Gm)^2 / n}$$

$$EC = Gm - Ge$$

The significance was adjusted first to p<0,05. The Person's linear correlation was used to evaluate the relation between two evaluation methods of corporal composition. The media of relative bodily fat was calculated by the two methods (PROT. 1 and PROT.2 and DXA). The analysis of residuals scores was done.

For the validity, it will be used the cut point of EPE < 3,0, because, following LOHMAN (1992), It is considered ideal for this kind of comparison.

To effectuate all the statisticians calculus, it was used the SPSS program, 11.5 version.

RESULTS AND DISCUSSION

Table 3- Descriptions characteristic of the sample

	Mean	SD	Min	Max
Age (years)	11,90	0,44	11,00	13,00
Stature (cm)	146,02	8,04	129,00	162,00
Corporal mass (kg)	37,09	8,08	27,00	60,00
$\%G_{DXA}$	15,87	5,76	6,00	32,70

The sample used in study shows homogeneous on the variables: age = 11,90,44; stature = 146,028,04; and corporal mass 37,098,08, the same doesn't occur with the variable $\%G_{DXA}$ = 15,875,76.

Table 2 Crossed validation of the SLAUGHER Equations (1988) for the estimative of relative corporal fat.

Methods	Mean	SD	Min	Max	r	t	EC	ET	EPE
$\%G_{DXA}$	15,87	5,76	6,00	32,70					
$\%G_{prot.1}$	19,06	4,74	11,70	31,50	0,91**	-6,04*	-3,20	3,98	0,99
$\%G_{prot.2}$	20,50	6,59	10,60	40,00	0,90**	-7,35*	-4,63	5,42	1,26

First, it is observed that as far as the **$\%G_{prot.1}$** and **$\%G_{prot.2}$** showed strong correlation with **$\%G_{DXA}$**, 0,91 and 0,90 respectively, being both correlations statistically meaning. T the same sense, BOWDEN *et al*. (2005), evaluating 108 children and adolescents in school age, found one correlation of 0,824 between the relative corporal fat measured by DXA and estimated by skinfold thickness.

The standards deviation and the minimum and maximum values of the **$\%G_{DXA}$**, **$\%G_{prot.1}$**, **$\%G_{prot.2}$** Demonstrate that PROT.1 tends to misjudge the highest values and overestimate the lowest values and PROT.2 shows contrary tendency of overestimate the highest values and misjudge the lowest values. However, when the medias were analyzed, it can be noticed that exists one strong tendency of two equations in overestimate the %G (CLAROS *et al*. 2000).

Though, in both equations, the value of EPE does not overtake the cut value adopted of 3,0%. By other side, it is observed that the ET was bigger than the EPE, in both equations, what indicates that the equations cannot be considered as a good predictor of the %G (PETROSKI 1995).

The averages values of **$\%G_{prot.1}$** and **$\%G_{prot.2}$** differentiate significantly of the averages values from **$\%G_{DXA}$**. It indicates that these equations are not good predictors of the %G. And the values from the Ecs of 3,20% and 4,63% found for **$\%G_{prot.1}$** and **$\%G_{prot.2}$**, respectively, confirm the tendency of both equations in overestimate the **$\%G_{DXA}$**. By other side, TOZUKA (2002) and BOWDEN *et al*. (2005) found contradictories values to these.

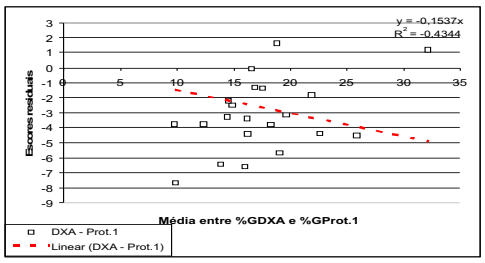

Figure 1 Analysis of the residuals scores of relative corporal fat obtained by dual-energy X-ray absorptiometry and PROT. 1 ($\%G_{DXA}$ - $\%G_{Prot.1}$) with the average of $\%G_{DXA}$ and $\%G_{Prot.1}$. It was utilized the procedure of Bland and Altman (1986). The dotted line represents the tendency between $\%G_{DXA}$ and $\%G_{Prot.1}$. The solid lines represent the limit for validation (standard error of estimative <3,0%).

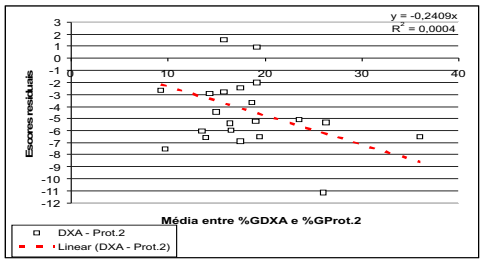

Figure 2- Analysis of the residuals scores of relative corporal fat obtained by dual-energy X-ray absorptiometry and PROT.2 ($\%G_{DXA}$ - $\%G_{Prot.2}$) with the average of $\%G_{DXA}$ and $\%G_{Prot.2}$. It was utilized the procedure of Bland and Altman (1986). The dotted line represents the tendency between $\%G_{DXA}$ and $\%G_{Prot.2}$. The solid lines represent the limit for validation (standard error

of estimative <3,0%).

Besides differences between averages and ET have been bigger than EPE, despite low EPE, when the residual scores are analyzed as far as PROT.1 at the Figure 1 and PROT. 2 in Figure 2, there were found results that impossibilities the equations validation of SLAUGTHER in this study.

Considering the cut point adopted, EPE= 3,0 %, only one part of the sample, 38,09%, for PROT. 1 and 33,33% for PROT. 2 of the sample represent values inside of validation limit. When the %G is estimated by PROT.1, 61,90% from sample is overestimate, because the difference between Gdxa% and Gprot.1 overtake the limit of 3,0%; in other words, the values that were found trough PROT. 1 are bigger than the values that were found when DXA is used. And still, when %G is estimated by PROT. 2, 66,66% of the sample is overestimated, because the difference between %Gdxa and %Gprot.2 overtake the limit of 3,0%; in other words, the values from PROT. 2 are bigger than values that were found when DXA is used.

The acceptable limit for PROT. 1, alternated between 1,64 and - 8,04, which shows a clear tendency of overestimate %G. At the same sense, the acceptable limit for PROT. 2 alternated between 1,12 and - 10,31, which demonstrate a much bigger tendency to overestimate %G. There were found values that overestimate, in more than 10%, the measure by DXA.

A possible explanation for this tendency from the equations in overestimate %G is the fact that, according to CLAROS *et al.* (2000), there is a light tendency of GXA in underestimate %G in children and adolescents when it is compared with hydrostatic weighing.

It can be explained by the fact that children have low density of bones due to less concentration of minerals, including calcium and also by bigger quantity of water inside the body that could take to a smaller corporal density.

Another limitation factor of the study could be the sample characterization related to race, because only 4 options are disengaged in the program, used by the DXA machine, to characterize the evaluated as for race. Due to the grat miscegenation of races in Distrito Federal, it becomes hard to characterize correctly. According to COTE & ADAMS (1993) and WAGNER & HEYWARD (2001) expressive differences in mineral density of bones are found in different races. This fact could be one more limitation from the machine that interfered at the results of mineral density of bones, originating, in some cases, the overestimating and, in others, the underestimating of this variable and consequently interfering at the results of %G estimate.

This fact has great relevance for the present study, therefore it takes to inference that people with smaller DMO can have the mineral mass of bone overestimate and, consequently, the fat mass and %G overestimated.

Nevertheless, the protocols of of corporal composition were validated in others pediatric populations. And according HEYWARD & STOLARCZYK (2000), HEYWARD (2001) and PETROSKI (2003) these equations are good signals of relative bodily fat and good options for population studies, and they are still the most used equations in Brazil for this goal. In this sense, TOZUKA (2002), in one study realized with 6 to 18 - year - old children, found high correlations of skinfold thickness with plethysmography e hydrostatic weighing, with values of $r^2 = 0,72$, respectively.

Some studies show that bodily corporation measurements can be significantly affected by many others factors, as: bone maturation ELLIS *et al.* (1995), BRUTON & ATKINSON (1993); age SNEAD, BIRGE & KOHRT (1993); sex WANG *et al*. (1989) and GOODSITT (1992); free mass of fat contained in skeleton MAZESS, PEPPLER & GIBBONS (1984); machine selection PRITCHARD *et al*. (1993) and ELLIS *et al*. (1994); software PINTAURO *et al*. (1996). All the studies were mentioned at same machine manual.

Therefore, it can be concluded that the equations PROT. 1 and PROT. 2 do not have cross validity at estimative of relative bodily fat from children with ages between 10 and 12 years from one public school in Brasilia, using as criterion referenced the DXA.

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MEASUREMENTS METHODS OF CORPORAL FAT IN CHILDREN
ABSTRACT

Introduction: The obesity is being considered a world epidemic, reaching all the age groups and a lot of populations, showing discharges correlations with many risk factors, besides in the pediatric population. It is necessary to evaluate the corporal composition, to verify the percentile of fat it is in healthy considerable levels. According to HEYWARD et al. 2001, the method antropométrico, now is the field method more used to determine the percentile of fat, due to application easiness in great populations, low cost of the equipments and invasive little.

Objective: To compare the results of two methods of measures of the percentile of fat in children.

Methods: The sample was constituted by 21 children from 10 to 12 years, with age (11,05 ± 0,38), stature (146,02 ± 8,04) and corporal mass (37,09 ± 8,08). The corporal fat was measured through two methods, and one of them using two protocols of the method SLAUGTHER (1988): PROT. 1 - it uses the folds triceps and subscapular (%GC = 0,783 x (doc) + 1,6) and PROT. 2 - triceps and calf (%GC = 0,735 x (doc) + 1,0). The second method was the dual-energy X-ray absorptiometry (DXA), using apparel of the Lunar mark, I model DPX-IQ, software " 4.6A. They were followed all the recommendations of the manufacturer and all the children had a free and illustrious form signed by the parents.

Results: The results found by the two methods they were: %GDXA (15,87 ± 5,76); %Gprot.1 (19,06 ± 4,74) and %Gprot.2 (20,50 ± 6,59).

Discussion: It is observed that the medium values of %Gprot.1 and of %Gprot.2 they differ significantly of the medium values of %GDXA, however. %Gprot.1 and %Gprot.2 presented strong correlation with %GDXA, 0,91 and 0,90, respectively, being both correlations significant. It is still the protocols of corporal composition, they were validated in other pediatric populations. This way becomes more necessary studies for better clarifications.

Key words: children, dual-energy X-ray absorptiometry and body composition.

COMPARAISON DES METHÒDES DE MESURE DE LA COMPOSITION CORPORELLE CHEZ DES ENFANTS.
RÉSUMÉ

Introduction: L'obesité est considerée une epidemie mondiale, en arrivant à toutes les tranches d'âge; et qui montre des correlations positifes avec pleusieur facteurs du risque assossié a des maladies chroniques non transmissible, inclusif dans la population pédiatrique. Une évaluation appropriée, de la composition corporelle, est nécessaire pour avoir une bonne condition de diagnostique. D'après Heyward et al. 2001, le méthode anthropométrique, est maitnant, la measure du terrain la plus utilizé por determiner le tissu adipeux, dû a la facilité d'application dans les grandes populations, le bas coût des materiels et peut envahissant.

Objectif : Comparer les résultats de deux méthodes de mesure de la adipositê chez des enfants.

Méthode : L´echantillon a été constitué de 21 enfants âges de 10 a 12 ans, le profil du groupe est agê 11,05 0,38), taille (146,02 8,04) et masse corporelle (37,09 8,08). La masse grasse a été déterminée d'après doux méthodes, d'abord les protocles de Slauther (1988) qui utlise deux equation : Prot. 1 utilse les plies cutanées de tricipital et sous-escapulaire (%GC=0,783x(doc)+1,6); Prot.2 en utilisant les plies cutânées de tricipital et mollet (% GC= 0,735x(doc)+1,0) ; en suite la méthode de l'obsortometrie d'double energie (DXA) en utilisant l' appareille Lunar DPX-IQ et logiciel 4.6A. On est été suivis toutes les recommandations du fabricabt. Les enfants ont presentés des consentement signée par des parents.

Resultas : les resultas presentés par des deux méthode sont les suivantes : %GDXA (15,87 5,76), %Gprot.1 (19,06 4,74) et %Gprot.2 (20,50 6,59).

Discussion : Il est observé que les valeurs moyennes de %G , entre les deux methodes, sont significativement different. Par contre les corrélations entre les deux méthode sont significatives (r= 0,91 et 0,90) respectivement. Cependant, il fout soulignér que les méthodes ont été valider chez des populations pédiatrique étrangères. Ainsi, d'outres études sont nécessaires pour meilleeures choisir le méthode le plus performante.

les mots clef: enfants, DXA et composition corporelle.

LA COMPARACIÓN DE MÉTODOS PARA MENSURAÇÃO DE GRASA CORPÓREA EN LOS NIÑOS
EL RESUMEN

La introducción: La obesidad es considerando una epidemia mundial, mientras alcanzando toda la edad se agrupa y muchas poblaciones, mostrando las correlaciones de las descargas con muchos factores de riesgo, además de en

la población pediátrica. Es necesario evaluar la composición corpórea, para verificar el percentil de grasa está en los niveles considerables saludables. Según el HEYWARD et al. 2001, el antropométrico del método, son ahora el método del campo más determinaba el percentil de grasa, debido a la comodidad de la aplicación en las grandes poblaciones, costo bajo de los materiales e pequeño invasive.

El objetivo: Para comparar los resultados de dos métodos de medidas del percentil de grasa en los niños.

Los métodos: La muestra se constituyó por 21 niños de 10 a 12 años, con la edad (11,05 ± 0,38), estatura (146,02 ± 8,04) y la masa corpórea (37,09 ± 8,08). la grasa corpórea era moderada a través de dos métodos, y uno de ellos que usa dos protocolos del método SLAUGTHER (1988): PROT. 1 - usa el tríceps de los pliegues y subescapular (%GC = 0,783 x (el doc) + 1,6) y PROT. 2 - el tríceps y ternero (%GC = 0,735 x (el doc) + 1,0). Y el segundo método era el absortometria de rayo-X de energía de la pareja (DXA), usando ropa de la marca Lunar, yo modelo DPX-IQ, software" 4.6A. Ellos fueron seguidos todas las recomendaciones del fabricante y todos los niños tenían una forma libre e ilustre firmada por los padres.

Los resultados: encontrados por los dos métodos que ellos eran: %GDXA (15,87 ± 5,76); %Gprot.1 (19,06 ± 4,74) y %Gprot.2 (20,50 ± 6,59).

La Discusión: Se observa que los valores elemento de %Gprot.1 y de %Gprot.2 ellos difieren significativamente de los valores elemento de %GDXA, sin embargo. %Gprot.1 y %Gprot.2 presentaron la correlación fuerte con %GDXA, 0,91 y 0,90, respectivamente, que son ambas correlaciones significante. Todavía es los protocolos de composición corpórea, ellos se validaron en otras poblaciones pediátricas. Este manera se vuelve los estudios más necesarios para las explicaciones buenas.

Key words: children, dual-energy X-ray absorptiometry, body composition.

COMPARAÇÃO DE MÉTODOS PARA MENSURAÇÃO DE GORDURA CORPORAL EM CRIANÇAS

RESUMO

Introdução: A obesidade está sendo considerada uma epidemia mundial, atingindo todas as faixas etárias e muitas populações, mostrando altas correlações com muitos fatores de risco, inclusive na população pediátrica. É preciso avaliar a composição corporal, para verificar se o percentual de gordura está em níveis consideráveis saudável. Segundo HEYWARD *et al.* 2001, o método antropométrico, atualmente é o método de campo mais utilizado para determinar o percentual de gordura, devido a facilidade de aplicação em grandes populações, baixo custo dos equipamentos e pouco invasivo.

Objetivo: Comparar os resultados de dois métodos de medidas do percentual de gordura em crianças.

Métodos: A amostra foi constituída por 21 crianças de 10 a 12 anos, com idade (11,05 ± 0,38), estatura (146,02 ± 8,04) e massa corporal (37,09 ± 8,08). A gordura corporal foi mensurada por meio de dois métodos, sendo que um deles utilizando dois protocolos do método SLAUGTHER (1988): PROT. 1 - utiliza as dobras tríceps e subescapular (%GC= 0,783 x (doc) + 1,6) e PROT. 2 - tríceps e panturrilha (%GC= 0,735 x (doc) + 1,0). E o segundo método foi a absortometria de raios-X de dupla energia (DXA), utilizando aparelho da marca Lunar, modelo DPX-IQ, "software" 4.6A. Foram seguidas todas as recomendações do fabricante e todas as crianças tiveram um formulário livre e esclarecido assinado pelos pais.

Resultados: Os resultados encontrados pelos dois métodos foram: $\%G_{DXA}$ (15,87 ± 5,76); $\%G_{prot.1}$ (19,06 ± 4,74) e $\%G_{prot.2}$ (20,50 ± 6,59).

Discussão: Observa-se que os valores médios de $\%G_{prot.1}$ e de $\%G_{prot.2}$ diferem significativamente dos valores médios da $\%G_{DXA}$, entretanto, $\%G_{prot.1}$ e $\%G_{prot.2}$ apresentaram forte correlação com $\%G_{DXA}$, 0,91 e 0,90, respectivamente, sendo ambas correlações estatisticamente significativa. E ainda os protocolos de composição corporal, foram validados em outras populações pediátricas. Desta forma torna-se necessário mais estudos para melhores esclarecimentos.

Palavras chaves: criança, absortometria de raios-X de dupla energia e composição corporal.