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Artigo Original

Type 1 diabetic body composition characterization by different methods: case report.

Caracterização da composição corporal do diabético tipo 1 por diferentes métodos: relato de caso.

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ABSTRACT

Introduction: Several body composition formulae exist. Otherwise, no one is specific to type 1 diabetes which has been used in gyms and health places, but without scientifical, comparison to analyze with gold standards. **Objective**: to characterize the body composition of an individual with DM1 and to compare it by different methods of body composition assessment. **Material and Methods**: First day, after anamneses, it was made basic anthropometric measurements (weight, height, perimeters, and skinfolds) and Dual-energy X-ray absorptiometry (DXA). Three formulas were used to compare with a gold standard (DXA). Descriptive values were used to analyze de comparisons. **Results**: DXA has shown 26.6%, 20.7 kg, and 57.2 kg to body fat percentage, fat mass, and Lean Mass, respectively. Deurenberg, Weststrate & Seidell shown 22.0%, 17.8 kg and 63.2kg. Jackson & Pollock, 35.9%, 29.0 kg and 52.0. Finally, Katch & McArdle, 19.0%, 15.4 kg and 65.6 kg. **Conclusion:** The equation of Deurenberg, Weststrate, and Seidell (1991) presented the lowest delta of variation concerning the body composition variables obtained by DXA. Thus, it is also possible to perform a body composition in people with type 1 diabetes through simpler techniques of assessment, such as equations based on body perimeter measurements and skinfolds.

Keywords: Body Composition; Diabetes; Fat Mass; Physical Assessment.

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RESUMO

Introdução: Existem várias fórmulas de composição corporal. Nenhuma específica para o diabético tipo 1, mas tem sido utilizada em academias e postos de saúde, porém sem respaldo científico comparado a padrão ouro. **Objetivo:** caracterizar a composição corporal de um indivíduo com DM1 e compará-la por diferentes métodos de avaliação da composição corporal. **Materiais e Métodos:** No primeiro dia, após a anamnese, foram feitas medidas antropométricas básicas (peso, altura, perímetros e dobras cutâneas) e absorciometria radiológica de dupla energia (DXA). Três fórmulas foram usadas para comparar com um padrão ouro (DXA). Valores descritivos foram usados para analisar as comparações. **Resultados:** DXA mostrou 26,6%, 20,7 kg e 57,2 kg de %gordura, massa gorda e massa magra, respectivamente. Deurenberg, Weststrate & Seidell mostrou 22,0%, 17,8 kg e 63,2 kg. Jackson & Pollock, 35,9%, 29,0 kg e 52,0. Katch & McArdle, 19,0%, 15,4 kg e 65,6 kg. **Conclusão:** A equação de Deurenberg, Weststrate e Seidell (1991) apresentou o menor delta de variação em relação às variáveis de composição corporal obtidas por DXA. Assim, também é possível realizar uma composição corporal em pessoas com diabetes tipo 1 por meio de técnicas mais simples de avaliação, como equações baseadas em medidas de perímetro corporal e dobras cutâneas.

Palavras-chave: Composição Corporal; Diabetes; Massa Gorda; Avaliação Física.

INTRODUCTION

Diabetes mellitus type 1 (DM1) is a metabolic disease in which β cells of the pancreas are destroyed by the body itself and the individual depends on exogenous insulin[1,2]. However, high doses of insulin are positively related to body fat accumulation[2,3]. Thus, it is important to DM1 person periodically evaluate and maintain body composition compartments (adequate fat and lean mass), since they may be harmful to the control and management of the disease throughout life[2].

Knowing that the assessment of body composition is the measurement of body components, quantitatively and qualitatively, to detect health risks or the state of performance of an individual is crucial to anybody. It could be done by different instruments and protocols (methods), which differ from one another concerning the accuracy of the technique, practicality, and cost[4].

However, the only method of direct measurement of body composition is the dissection of cadavers. Thus, Dual-energy X-ray absorptiometry (DXA), despite being an indirect measure, is considered the gold standard method for this evaluation in living individuals[5]. In addition to being an instrument with high precision and good intra and inter-rater reproducibility[6]. On the other hand, anthropometry, despite being a doubly indirect measure, is still the method most used for its low cost and practicality. Therefore, the objective of the present study was to characterize the body composition of an individual with DM1 and to compare it with different methods of body composition assessment.

MATERIAL AND METHODS

Population, sample and ethical aspects

The research population was people with type 1 diabetes, which the volunteer was recruited in the “mouth-to-mouth”, at the Health Campus of the University of Pernambuco in the year 2017 and through social media related to the diabetic population. The sample was for convenience, composed of an individual with type 1 diabetes, who agreed and voluntarily participated in the research and, after explaining the study and performing anamnesis, signed the Informed Consent Term.

Inclusion criteria in this study were female and male subjects; who regularly use insulin and have no osteoarticular, muscular, peripheral neuropathy, or any complication or complication caused by diabetes, which impedes the performance of the sessions. The present study was submitted and

approved by the Ethics and Research Committee (Nº: 029770/2016; CAEE: 55081916.9.0000.5192), according to Resolution 466/12 of the National Health Council.

Research design

Initially, laboratory measurements (lipid profile and glycated hemoglobin) were performed at the Marcelo Magalhães Laboratory with ISO 9002 certification. After that, they went to the Human Performance Assessment Laboratory to perform basic anthropometric measurements (weight and stature) and DXA. The BMI, perimeters and skinfold measurements were used to calculate % body fat (%BF), fat mass (FM) and lean mass (LM). Finally, after rest (10-minute sitting position), baseline cardiovascular measurements (heart rate, blood pressure, and subsequent double product calculation) were performed.

Before the initial analysis, the volunteers were instructed to abstain from alcohol, smoking, and vigorous physical activity in the previous 24 hours and to carry out their normal eating habits. In addition, they used light and appropriate clothing. All the body composition evaluation steps were performed at the CENESP in the Human Performance Evaluation Laboratory with temperature (24 ± 2 ºc), air humidity (40-60%) and an atmospheric pressure of (approximately 760 mmHg) controlled by an environmental station.

Techniques and instruments

Laboratory measures

Initially, laboratory measurements (lipid profile and glycated hemoglobin) were performed at the Marcelo Magalhães Laboratory with ISO 9002 certification.

Anthropometry, body composition formula and DXA

In order, for the anthropometric measurements, the body mass was analyzed in kilograms using a digital scale (Filizola, Brazil), with an accuracy of 0.1 kg and height in centimeters, using a wooden stadiometer mounted with a scale in mm. The BMI was calculated by the formula:

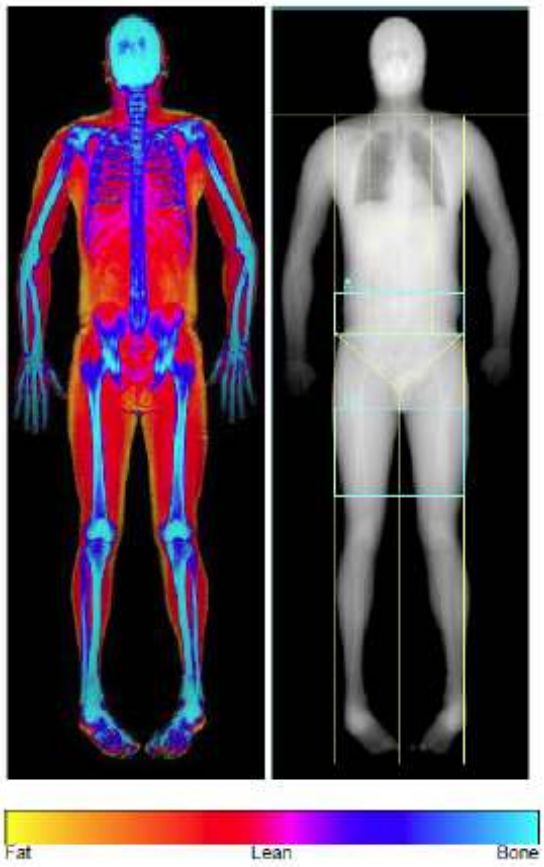
$$\frac{Body\ mass\ (kg)}{Stature\ (m)^2}$$

Measurement of perimeters and skinfolds followed internationally standardized techniques[7]. Subsequently, the measurements were used in several equations. First, in the equation of Deurenberg, Weststrate and Seidell[8], for the estimation of body fat (%BF = 1,2 x BMI + 0,23 x age - 10,8 x sex - 5,4), being the value 0 for male sex and 1 for female sex; In the equation of Jackson and Pollock[9], which uses seven skinfolds (SSF) to estimate the body density (BD) of adult males (BD = 1,11200000 - [0,00043499 (SSF) + 0,00000055 (SSF)²] - [0,0002882 (age)]); and in the Katch and McArdle equation[10], for men between 27 and 50 years (%BF = Constant A + Constant B – Constant C – 15) and finally, the body density values obtained by Jackson and Pollock9 and Katch and McArdle[10] were used in the Siri[11] equation to calculate body fat by the following formula %BF=((4,95/body density)−4,5) x 100.

The DXA was performed following the manufacturer's guidelines, with the following protocol: initially, before each collection, the calibration of the equipment was performed. Next, the subject's history was filled out with the insertion of data such as weight, stature and, ethnicity. To perform the test, the volunteer was instructed to wear light clothing and without metal, lie down in the supine position, with his head still and looking at the ceiling. It was positioned with a straight body on the table and centered with the lines on the tabletop, including those on the headboard and the side of the feet

so that it was completely enclosed in the area for examination. With the arms positioned at the side of the body, the hands are pronounced and away from the body, the hip and, feet turned inward (hip in inversion) around 25º, pointing upwards. The volunteer remained motionless, attempting to maintain normal breathing during the scan, which lasts for an average of 6 minutes. The image obtained by DXA is shown in Figure 1.

Figure 1. Image obtained by DXA to measure of body composition.



Cardiovascular measures

In the cardiovascular measurements, the heart rate was analyzed in the passive rest after 10 minutes (sitting position) by a frequency of the mark Polar (model FT4, Finland). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in passive rest after 10 minutes (sitting position) by an automatic blood pressure meter (Model OMRON HEM 7113, Kyoto, Japan).

Statistical analysis

A descriptive analysis was performed using Excel program of Windows Office Package (2013).

RESULTS

Table 1 presents the description of the sample (socio-demographic aspects, cardiovascular, lipid profile and anthropometric and skin folds).

Table 1. Basic characteristics of the sample.

	Man
Age (anos)	34
Peso (kg)	81
Stature (cm)	179
BMI (kg/m²)	25.3
History of diabetes in the family	Yes (DM2)
Rest heart rate (bpm)	76
Systolic blood pressure (mmHg)	120
Diastolic blood pressure (mmHg)	69
Glycemic Hemoglobin (%)	7.7
HDL cholesterol (mg/dL)	66
LDL cholesterol (mg/dL)	122
Total cholesterol (mg/dL)	206
Triglycerides (mg/dL)	88

Anthropometric variables

Perimeters (cm)		*Skin Folders* (mm)	
Chest	98	Biceps	12
Waist	86	Triceps	18
Abdomen	90	Subscapular	16
Hip	95	Chest	14
Right arm	34.5	Axillary	17
Left arm	33.5	Iliac crest	26
Right forearm	29	Front thigh	33.5
Left forearm	28.5	Medial calf	11
Right thigh	57	Abdominal	35
Left thigh	56		
Right leg	27		
Left Leg	26		

BMI – Body mass index; HDL - High Density Lipoproteins; LDL - Low Density Lipoproteins; DM2 – Diabetic type 2 person. Note: Chest and Axillary skin folders were used according to Jackson and Pollock (1978).

The DXA presented a fat percentage of 26.6%, with the equations of Deurenberg, Weststratte and Seidell (8) and Katch & McArdle (10) estimating smaller values, 22% (Δ% = -17.4) and 19% (Δ% = -28.6), respectively in comparison to DXA. And Jackson and Pollock's equation (9) shown a higher result (35.9%, Δ% = 34.8). These relationships were maintained in the fat mass measurements, in kilograms, where the values of 17.8 kg (Δ% = -14.1, Deurenberg, Weststratte & Seidell (8)), 15.4 kg (Δ% = -25.7, Katch & McArdle (10)) and 29 kg (Δ% = 40.2, Jackson and Pollock (9)) (Frame 1).

Frame 1. Body Fat percentage and Fat and lean mass in different methods.

	DXA	Deurenberg, Weststrate & Seidell (1991)	Δ (%)	Jackson & Pollock (1978)	Δ (%)	Katch & McArdle (1984)	Δ (%)
BF (%)	26.6	22.0	-17.4	35.9	34.8	19,0	-28.6
FM (kg)	20.7	17.8	-14.1	29.0	40.2	15,4	-25.7
LM (kg)	57.2	63.2	10.6	52.0	-9.1	65,6	14.8

BF: Fat percentage; FM: fat mass; LM: lean mass.

DISCUSSION

The main of this study was to characterize the body composition of DM1 and to compare it by different methods of body composition assessment. Although there are no statistical analyses, in a descriptive form of the values found according to these formulas, the equation which was closer to DXA in BF, FM, and MM was Deurenberg, Weststrate & Seidell equation[8].

In an overview of % BF, the equations of Deurenberg, Weststrate & Seidell[8] and Katch & McArdle[10] underestimated body fat measurements (respectively, 22% and 19%, 17.8 kg and 15.4 kg) when compared to the results obtained by the DXA. The DXA, when calculating the percentage of body fat, considers the measurement of visceral fat, whereas the equations used to estimate only the subcutaneous fat[12]. While the first one uses BMI and age, the second is based on body perimeters for estimating body density and subsequent application in the Siri formula (1960), for the calculation of the percentage of body fat.

On the other hand, the percentage of fat (35.9%) calculated using the body density obtained with the equation of Jackson and Pollock[9], which uses seven skinfolds, was higher than that measured by DXA (26.6%). Thus, this would not be an equation indicated to be used in estimating the body composition of this individual, which can be applied to the population in which he is inserted. Thus, further characterization studies of the body composition of young adults with DM1 are necessary, using other equations that use skin folds and a representative sample of the population.

Costa et al.[4], who compared different equations with hydrostatic weighing (HW) in healthy people, found a moderate correlation between the equation of Katch & McArdle[10] and HW, which is also considered a gold standard for the measurement of body composition. Otherwise, our study presented a percentage of fat (19%) lower than DXA (26.6%). Meanwhile, Deurenberg, Weststrate & Seidell[8] (22%) had the value of the estimated fat percentage closer to the value measured by the DXA.

Obviously, these values are expected to be found similarly in the amount of body fat analyzed in kilograms once the % BF was closer to DXA. Thus, the formula of Deurenberg, Weststrate & Seidell[8] (17.8 kg; -14.1%) represent the values closest to that found in the DXA (20.7 kg). And also, similar results were found in MM (57.2 vs 63.2 kg). Nevertheless, the Jackson and Pollock[9] formula, which uses seven skinfolds, supra estimated the %BF and FM (kg), which underestimated the MM (kg). In another hand, Katch & McArdle[10] formula which uses the body perimeters for estimating body density and subsequent application in the Siri formula, underestimated the %BF and FM (kg) and for this, supra estimated the MM (kg) in comparison with DXA.

This information could help professionals at gyms and other healthy places which uses the body assessment in general people. Knowing that the evaluated is a type 1 and the places do not have DXA, a simple formula with anthropometric measures could be useful in practice. Still, the present study had limitations. First, the analysis of a single male volunteer. Notwithstanding, the population is scarce and it needs more information about. According to Gonder-Frederick[13], approximately 10% of diabetes mellitus studies has the theme of DM1. Knowing the metabolic sex differences[14], other studies should analyze females, which could also control the menstrual cycle that can cause changes in the circadian cycle.

CONCLUSION

The equation of Deurenberg, Weststrate, and Seidell[8] presented the lowest delta of variation in the body composition variables obtained by DXA. Thus, it is also possible to perform a body composition in people with type 1 diabetes through simpler techniques of assessment, such as equations based on body perimeter measurements and skinfolds.

Contribution

JLBG: Design, data collection, writing and final analysis.

MBCG: Writing and final analysis.

MCC: Design, writing and final analysis.

Conflict of Interest

None.

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