Anthropometric and bio-impedance data in relation to physical independence in elderly

Date antropometrice şi de bioimpedanţă în relaţie cu menţinerea independenţei fizice la vârstnici

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Abstract

Background. Physical and functional changes occurring with age appear gradually and they inevitably progress over time, but the rate of progress is very different from one person to another. Sedentary elderly may lose fitness with age, up to loss of independence, and increased physical activity can counteract this, while being beneficial also in the development of chronic diseases.

Aims. All these changes occurring in the bone - muscle system can be identified by investigating the anthropometric indicators.

Methods. Two groups of elderly were studied: 116 institutionalized elderly, aged 65-84 years, 122 non-institutionalized elderly, aged 65-78 years. A series of anthropometric indicators as well as body composition were determined by the impedance method.

Results. Following determinations, a greater representation of fat mass compared to non-fat mass was found, especially in women, which were classified as overweight 2nd degree. The body mass index values obtained in the studied groups were correlated with skin fold values and were lower in non-institutionalized elderly people. Data processing also led to the obtaining of higher body fat levels (percentage and kg) in institutionalized elderly. The calculated total muscle mass evidenced higher values in the group of non-institutionalized elderly.

Conclusions. a) The proportion of fat is increased in both female groups compared to male groups. b) The differences between the mean fat tissue values in the two groups can be explained if we consider that institutionalized elderly have extremely reduced physical activity, either due to the lack of sport facilities in the institutions concerned or because of associated chronic diseases further limiting the exercise capacity. c) The assessment of nutritional status using the bio-impedance method provides important information on body fat and allows for a more careful monitoring of nutritional and cardiovascular risk.

Key words: elderly, anthropometry, bio-impedance, physical independence.

Rezumat

Premize. Modificările fizice şi funcţionale apărute cu înaintarea în vârstă apar treptat şi progresează inevitabil în timp, rata de progresiune fiind însă foarte diferită de la o persoană la alta. Persoanele vârstnice sedentare pot pierde forma fizică odată cu vârsta, până la pierderea independenţei, iar creşterea activităţii fizice poate contracara acest lucru, fiind benefic şi pentru evoluţia bolilor cronice.

Obiective. Toate aceste modificări, apărute la nivel osteomuscular, pot fi evidenţiate prin investigarea indicatorilor antropometrici.

Metode. Au fost luate în studiu două loturi de vârstnici: 116 vârstnici instituţionalizaţi, cu vârste cuprinse între 65-84 de ani şi 122 vârstnici neinstituţionalizaţi, cu vârste cuprinse între 65-78 de ani. S-au determinat o serie de indicatori antropometrici, precum şi compoziţia corporală prin metoda impedanţei.

Rezultate. În urma determinărilor efectuate s-a observat o reprezentare mai mare a ţesutului adipos faţă de masa neadipoasă, în special la femei, acestea încadrându-se în supraponderie gradul II. Valorile Indicelui de Masă Corporală obţinute la loturile luate în studiu sunt corelate şi cu valori pliurilor cutanate, la vârstnicii neinstituţionalizaţi acestea fiind mai mici. Prelucrarea datelor a condus, de asemenea, şi la obţinerea unor valori mai mari ale ţesutului gras (procentual şi în kg) la vârstnicii instituţionalizaţi. Masa musculara totală calculată evidenţiază valori mai mari la lotul de vârstnici neinstituţionalizaţi.

Concluzii. a) Proporţia de ţesut adipos este mai mare la ambele loturile feminine, comparativ cu cele masculine. b) Diferenţele între valorile medii ale procentului de ţesut adipos la cele două loturi sunt explicabile dacă ţinem cont de faptul că la vârstnicii instituţionalizati activitatea fizică este extrem de redusă, fie datorită lipsei de dotare a instituţiilor respective cu o sală de sport, fie datorită bolilor cronice asociate care limitează şi mai mult capacitatea de efort. c) Evaluarea stării de nutriţie prin metoda de bioimpedanţă aduce informaţii importante legate de compartimentul de grăsimi şi posibilitatea urmăririi mai atente a riscului nutriţional şi cardiovascular.

Cuvinte cheie: vârstnici, antropometrie, bioimpedanţă, independenţă fizică.

Introduction

As we age, our body undergoes changes in many respects, which affect the functions of individual cells as well as of organs and systems. These inevitable changes occur gradually over time, but the rate of progress is very different from one person to another (Ciuciuc, 2011).

One of the most important factors influencing the quality of life in the elderly has been the maintenance of aerobic capacity and independence.

Regular exercise reduces the risk of obesity, diabetes, hypertension and cardiovascular disease, not only at middle ages but also after retirement age, and the maintenance of aerobic capacity at old age may be associated with the ability to maintain independence (***, 2002; Campillo et al., 2004; Stanciu, 2008).

Sedentary elderly may lose fitness with age, up to loss of independence, while increased physical activity may counteract it, being also beneficial for the development of chronic diseases (Thorpr et al., 2004).

Physical and physiological decline (musculoskeletal, cardiovascular, gastrointestinal, respiratory) may be associated with the aging process exacerbated by a number of spinal cord injuries. The rate of decline varies from one individual to another, being dependent on genetic heritage, customs, lifestyle and general health (Huges et al., 2004).

The effects of physical inactivity in the elderly translate into: osteoporosis, with an increase in fracture rates (femoral neck, spine, distal forearm), muscle weakness especially in the legs, with an increased risk of falls and decreased flexibility, with the occurrence of frequent accidents and injuries. Sedentary life increases the risk of cancer (colon, female genital apparatus) and causes a higher frequency of coronary artery disease and high blood pressure (Lazăr et al., 2007; Prelici & Barbat, 2007).

Musculoskeletal changes occurring in the elderly include:
- decrease in muscle mass,
- decrease in muscle fiber size and number of myofibrils.

All these changes at musculoskeletal level may be evidenced by investigating anthropometric indicators.

Nutrition and physical activity are effective ways to prevent chronic diseases such as atherosclerosis, hypertension, metabolic disorders and their complications. The WHO has published a series of guidelines on physical activity, whose effects on diabetes, cardiovascular disease, hypertension also translate into reduced demand for care in medical institutions, lower consumption of drugs, as well as maintenance of the autonomy of the elderly (Kondrup et al., 2003; Chen et al., 2007).

Numerous studies show that maintaining a workout schedule early in the adult period counteracts age-related decline in exercise capacity and increases the period of independence in the elderly (Gillette-Guyonnet et al., 2003; Forster & Gariballa, 2005; Keller, 2005; Reyes-Beaman, 2005; Harris et al., 2008).

Hypothesis

This study aims to assess comparative anthropometric and bio-impedance data in 2 groups of elderly in relation to the maintenance of physical independence.

Materials and methods

Research protocol
To achieve the intended aim, we used a case-control study.

a) *Period and place of research*
The study was conducted in 2003-2004. Anthropometric data evaluation was performed in a group of institutionalized elderly in the Care and Support Center of Cluj-Napoca vs. a group of non-institutionalized elderly.

b) *Subjects and groups*
Two groups of elderly were studied:
- 116 institutionalized elderly, out of which:
  - 64 women, aged between 65-79 years;
  - 52 men, aged between 70-84 years;
- 122 non-institutionalized elderly, out of which:
  - 68 women, aged between 65-79 years;
  - 54 men, aged between 70-84 years;

The measurements were performed with the subject standing, but many elderly people had difficulties in maintaining an orthostatic position; some subjects were even confined to chair or bed for various conditions; the elderly who were not able to maintain postural position were excluded from this study.

c) *Test applied*
We used direct methods for the determination of anthropometric parameters such as height, weight, mean arm circumference, skin folds (tricipital, bicipital, suprailiac and subscapular), and the calculation of correlative indicators such as: body mass index (BMI), muscular arm circumference (MAC), arm muscular area (AMA), muscle mass (MM) and the amount of subcutaneous fat (Santos et al., 2004; Ciuciuc, 2011).

In this study, body composition in the elderly was also evaluated using the bio-impedance method - a non-invasive and quick method to assess the risk of nutritional status disorders.

d) *Statistical processing*
The results were expressed as arithmetic mean. Statistical analysis was performed using Microsoft Office Excel 2010.

Results

For interpreting the results, we divided the investigated subjects into two groups: institutionalized elderly (IE) and non-institutionalized elderly (nIE), both split per gender.

After calculating the BMI value for the studied elderly, the following results were obtained:
- IE group
  - women: BMI = 32.65 => overweight 2nd degree
  - men: BMI = 21.19 => normal weight
- nIE group
  - women: BMI = 31.05 => overweight 2nd degree
  - men: BMI = 22.03 => normal weight

The differences in BMI values may be explained by culinary traditions and lifestyle as well as genetics.

The results obtained in the groups under study were correlated with lower skin fold values in non-institutionalized elderly, thus explaining their lower average weight (Tables I and II).

Table I
Anthropometric parameters in non-institutionalized elderly.

Parameter	Gender	
	F	M
Age (years)	70.5	71.5
Height (cm)	159	165
Shank length (cm)	42.5	43
Weight (kg)	81	60
BMI	31.05	22.03
Shank perimeter (cm)	35.5	29
Brachial perimeter (cm)	34	25
Subscapular skin fold (cm)	3.7	0.9
Tricipital skin fold (cm)	2.7	0.9
Bicipital skin fold (cm)	3.1	0.7
Suprailiac skin fold (cm)	3.3	2
Fat tissue composition	40.6%	31.3%
	32.9 kg	17.8 kg

Table II
Anthropometric parameters in institutionalized elderly.

Parameter	Gender	
	F	M
Age (years)	72	77
Height (cm)	157.5	164
Shank length (cm)	41	43
Weight (kg)	78.5	57
BMI	32.65	21.19
Shank perimeter (cm)	36	27.5
Brachial perimeter (cm)	35	24
Subscapular skin fold (cm)	4.1	0.9
Tricipital skin fold (cm)	3.3	0.8
Bicipital skin fold (cm)	3.4	0.7
Suprailiac skin fold (cm)	3.8	2.5
Fat tissue composition	44.4%	36.3%
	36 kg	20.7kg

Data processing also showed higher levels of fat, in both percentage and net weight, in institutionalized elderly.

The calculated total muscle mass (TMM) evidenced higher values in the group of non-institutionalized elderly.

- IE group
  - women: TMM = 23.26 kg
  - men: TMM = 17.07 kg
- nIE group
  - women: TMM = 25.11 kg
  - men: TMM = 18.30 kg.

Even for non-adipose mass, the non-institutionalized elderly had values higher than those of the institutionalized elderly of both genders (Tables III and IV).

Table III
Body composition parameters innon-institutionalized elderly.

Parameter	Gender	
	F	M
Age (years)	72	77
Adipose mass (%)	52.3%	42%
Adipose mass (kg)	42.36	23.52
Total muscle mass (kg)	23.26	17.07
Non-adipose mass (kg)	38.63	33.48

Table IV
Body composition parameters ininstitutionalized elderly.

Parameter	Gender	
	F	M
Age (years)	70.5	71.5
Adipose mass (%)	44.9%	41%
Adipose mass (kg)	35.24	24.6
Total muscle mass (kg)	25.11	18.30
Non-adipose mass (kg)	43.26	35.4

Discussion

Following measurements, higher adipose mass values compared to non-adipose mass values were found, especially in women, which were classified as overweight 2nd degree – which was also a useful indicator in assessing cardiovascular risk.

A greater muscle mass in non-institutionalized elderly explains some of their higher weight compared to institutionalized elderly.

Also, the lack of activity in the group of institutionalized elderly and a series of associated chronic diseases cause a higher muscle mass loss.

By analyzing the results of lean muscle mass, adipose mass percentage and average weight in the two groups, we can explain the weight difference not only in terms of muscle mass but also of body fat percentage.

Comparative bio-impedance data show a lower adipose mass percentage in non-institutionalized elderly, with a greater difference in women, 7.4%, while in men the difference is only 1%.

Muscle tone and physical and mental health are also better in non-institutionalized persons. The same is true for fat mass expressed in kg, where the difference between the two genders is surprisingly great. If fat mass is 42.36 kg in institutionalized women and 35.24 kg in non-institutionalized women, in men, fat mass is 23.52 kg and 24.6 kg, respectively.

Total muscle mass expressed in kg is lower in institutionalized elderly compared to non-institutionalized elderly. In women, total muscle mass is 23.26 kg and 25.11 kg, respectively, while in men, it is 17.07 kg and 18.30 kg, respectively.

Conclusions

1. The proportion of adipose tissue is increased in both female groups compared to males. The mean percentage values of adipose tissue out of the total weight fall into the 2nd degree of obesity in women, while in the group of men, values remain within normal weight.

2. These differences can be explained if we consider that institutionalized elderly have extremely reduced physical activity, either because of the lack of facilities (a gym, for example), or because of associated chronic diseases which further limit the exercise capacity.

3. The assessment of nutritional status using the bio-impedance method provides important information about body fat and a better traceability of nutritional and cardiovascular risk. Therefore, the bio-impedance method should be introduced in the medical assessment of the elderly.

4. The investigation of nutritional status in elderly communities is an important issue of preventive medicine. The assessment of nutritional status may detect possible nutritional deficits at an early stage. Evaluation in this age group is also required because of physiological changes occurring in the aging process.

5. The results obtained recommend a greater involvement of the elderly in various social activities, as well as in family activities, which allows for maintaining their sense of utility, a particularly important factor for the

maintenance of good nutrition and indirectly, good health. It avoids the occurrence of depression, commonly seen in the elderly.

Conflicts of interest

There are no conflicts of interests.

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