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RESEARCH

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COMPARATIVE STUDY ON THE CONDITIONS OF ANEMIA IN ELDERLY

Estudo comparativo sobre as condições de anemia em idosos

Estudio comparativo sobre las condiciones de anemia en idosos

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ABSTRACT

Objective: To compare sociodemographic, behavioral characteristics, health conditions and laboratory parameters among anemic and non - anemic elderly. **Methods:** Cross-sectional epidemiological study with 257 elderly subjects. To perform comparisons, the t-test for independent samples and the non-parametric Mann-Whitney U test were used. **Results:** There was a higher proportion of anemia in the elderly over 80 years (p = 0.026), and a higher proportion of dependence on basic activities (p = 0.018) and instrumental (p = 0.010) daily activities in elderly patients with anemia. Differences were observed in the distribution of laboratory parameters, with mean values of urea and creatinine being higher in anemic elderly, with lower concentrations of glycemia, albumin, ALT / TGP, serum calcium and total T_3. **Conclusion:** Anemia is not exclusively related to the aging process, but is a result of multiple factors such as sociodemographic, health, food and life conditions of the elderly.

Descriptors: Anemia; Hemoglobin; Aging.

RESUMO

Objetivo: Comparar características sociodemográficas, comportamentais, condições de saúde e parâmetros laboratoriais entre idosos anêmicos e não anêmicos. **Métodos:** Estudo epidemiológico transversal realizado com 257 idosos. Para realizar as comparações utilizou-se o teste t para amostras independentes e o teste não paramétrico U de Mann-Whitney. **Resultados:** Encontrou-se maior proporção de anemia em idosos com idade acima de 80 anos (p=0,026), e maior proporção de dependência para atividades básicas (p=0,018) e instrumentais (p=0,010) da vida diária em idosos com anemia. Identificou-se diferença na distribuição da dosagem dos parâmetros laboratoriais, sendo as concentrações médias de ureia e creatinina maiores nos idosos anêmicos, e esses tiveram menores

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concentrações de glicemia, albumina, ALT/TGP, cálcio sérico e T_3 total. **Conclusão:** A anemia não está relacionada exclusivamente ao processo de envelhecimento, mas sim resultado de múltiplos fatores como as condições sociodemográficas, de saúde, alimentares e de vida dos idosos. **Descritores:** Anemia, Hemoglobina, Envelhecimento.

RESUMÉN

Objetivo: Comparar características sociodemográficas, comportamentales, condiciones de salud y parámetros de laboratorio entre ancianos anémicos y no anémicos. **Metodo:** Estudio epidemiológico transversal realizado con 257 ancianos. Para realizar las comparaciones se utilizó la prueba t para muestras independientes y la prueba no paramétrica U de Mann-Whitney. **Resultados:** Se encontró mayor proporción de anemia en ancianos con edad superior a 80 años (p = 0,026), y mayor proporción de dependencia para actividades básicas (p = 0,018) e instrumentales (p = 0,010) de la vida diaria en ancianos con anemia. Se identificó diferencia en la distribución de la dosificación de los parámetros de laboratorio, siendo las concentraciones medias de urea y creatinina mayores en los ancianos anêmicos. **Conclusión:** La anemia no está relacionada exclusivamente con el proceso de envejecimiento, sino el resultado de múltiples factores como las condiciones sociodemográficas, de salud, alimentos y de vida de los ancianos.

Descriptores: Anemia; Hemoglobina; Envejecimiento.

INTRODUCTION

Anemia is a pathological condition characterized by a reduction in the levels of hemoglobin (Hb) in the blood, with or without a decrease in the number of red blood cells, considering the limit values of Hb <12 g/dL for women and <13 g/dL for men.[1] The complete blood count is the complementary exam that allows quantitative and qualitative assessment of the cellular elements of the blood, with the Hb measurement being the hematological value for assessing the condition of anemia.[2]

Because anemia is considered to be of multifactorial origin,[3,4] it is relevant to assess other parameters besides hematological ones, such as biochemical tests, clinical enzyme, hormonal and protein measurements, among others.[5] Among the biochemical tests, the dosage stands out uric acid, serum calcium, blood glucose, lipoprotein components, urea, and creatinine; clinical enzyme assesses amylase, glutamic-oxalacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), alkaline phosphatase and gamma-glutamyltransferase (GGT). Protein dosage measures the total amount and fractions of proteins, including albumin; hormonal dosages mainly assess thyroid function, and include thyroid-stimulating hormone (TSH), triiodothyronine (total and free T_3) and thyroxine (total and free T_4).[5]

Anemia has a high incidence in elderly people,[6] and increases with age,[3,6] and longevity,[7] and has been related to increased mortality, worsening morbidity, frailty, decline in functional and cognitive capacity,[3] therefore, the occurrence of anemia should not be attributed only to the aging process,[8] but also to social, economic and health conditions, and some unexplained causes.[4] Hence, a multidimensional approach to elderly people should add clinical and laboratory evaluation, an investigation regarding the autonomy and independence of elderly people regarding the performance of both basic and instrumental activities of daily living.

Distinctions in sociodemographic, behavioral, health and laboratory indicators have been related to the condition of anemia in elderly people,[9] and in males.[7,10,11] Anemia has been related to the reporting of thyroid disease, diabetes and depressive symptoms,[11,12] lower albumin dosage,[2] genetic disorders,[13,14] and chronic diseases.[2,14]

Bearing in mind the aforementioned, the present study meant to compare sociodemographic, behavioral characteristics, health states and laboratory parameters among both anemic and non-anemic elderly people, who lived in a small city that show unfavorable social indicators.

METHODS

It is an epidemiological, cross-sectional and analytical study, which counted with the participation of individuals aged 60 years old or more, residing in the urban area of the *Aiquara* city (4,602 citizens), located in the south-central region of the *Bahia* State.[15] Herein, the participants were identified after home visits to all households, in the form of an active search. So, elderly people from both genders, non-institutionalized and who slept at least three nights at home, were considered able to participate in the study.

The census survey found 379 elderly people, those who were not located after three visits on different shifts (n=34), with cognitive impairment and without a companion to assist in the answers (n=36), who refused to participate in the study (n=20), without blood samples collected (n=30) and who were using nutritional supplements of iron, vitamin B12 and folic acid (n=2) did not participate in the study. Thus, the study population was 257 elderly subjects.

Data collection took place in four stages between January and August 2015. The first stage was carried out by applying a questionnaire that included sociodemographic, behavioral and health conditions, having been answered by an elderly alone or with the assistance of a companion in the home.

The second stage included the assessment of nutritional status by measuring anthropometric measurements, with the body mass index (BMI) being calculated. The Plenna® scale was then used to measure the weight, with a maximum capacity of 180 kilograms, and for the height measurement, the Wiso® stadiometer, with the equipment calibrated daily, paying attention to elderly people regarding the use of light clothing and without shoes.

The third stage consisted of collecting blood samples. In addition to the complete blood count, the following laboratory tests were performed: fasting glucose, total cholesterol and fractions, triglycerides, uric acid, serum calcium, urea, creatinine, total proteins, albumin, GOT, GPT, GGT, alkaline phosphatase, amylase, total T_3, total and free T_4, and TSH. To perform this step, a 12-hour overnight fast was requested, and the technical procedure was performed at home when it was impossible for the elderly to attend the previously established place.

Conclusively, the stool samples collection was done at the elderlies' homes, where they were instructed to collect it, preferably, on the same day it would be taken away.

Both blood and stool samples were properly packed in cool boxes with reusable ice at a temperature of +2°C to +8°C without direct contact with the ice and then transported to the Public Health Laboratory of the Referral Center for Endemic Diseases *Pirajá da Silva* (PIEJ) in the municipality of *Jequié*, *Bahia* State, where they were processed and analyzed.

For measuring the blood glucose, blood plasma was used in fluoride, and for the other biochemical tests, the samples collected were centrifuged. For the analysis of the complete blood count, whole blood with EDTA was used from the automatic hematology analyzer ABX Micros 60 with technology based on the impedance principle through the electronic counting method. Colorimetric enzymatic method and the SELLECTRA II equipment were used to measure blood glucose, GOT, GPT and GGT, calcium, urea, creatinine, triglycerides and total cholesterol. HDL was measured only using the direct precipitation method. LDL was expressed using the Friedewald equation. For the analysis of the hormones total T_3 and T_4, free T_4 and TSH, the chemiluminescence method and the ARCHTTECT equipment were used. The parasitological stool sample exam was performed from a single sample and aimed to investigate the presence of parasites, using the Hoffman method in all samples and, when positive result for *Schistosoma mansoni*, the Kato-Katz technique was added.

Considering the laboratory variables, the World Health Organization (WHO) standard was used to define anemia, with values of Hb <12 g/dL for women and Hb <13 g/dL for men,1 so the elderly people were categorized as anemic and non-anemic.

The reference values considered normal for the other laboratory tests were, as follows: for fasting blood glucose below 100 mg/dL;[16] total cholesterol below 200 mg/dL, low density lipoprotein (LDL-cholesterol) below 100 mg/dL, very low density lipoprotein (VLDL-cholesterol) below 40 mg/dL, high density lipoprotein (HDL-cholesterol) above 60 mg/dL and triglycerides below 150 mg/dL;[17] uric acid between 2 and 7 mg/dL; urea between 10 and 50 mg/dL; creatinine between 0.5 and 1.4 mg/dL; GGT between 8 and 41U/L; alkaline phosphatase from 5 to 230 U/L; amylase from 28 to 100 U/L (PIEJ Laboratory); serum calcium from 8.5 to 10.5 mg/dL;[18] GOT from 10 to 30 U/mL and GPT from 10 to 32 U/mL;[19] total proteins from 6.4 to 8.1 g/dL; albumin between 3.5 and 5.5 g/dL;[20] T_3 from 0.8 to 1.8 ng/mL, free T_4 from 0.7 to 1.8 ng/dL, total T_4 from 4.5 to 12, 6 ng/dL, TSH from 0.4 to 4.5 μUI/mL.[21]

The functionality was assessed based on the elderly's ability to perform Activities of Daily Living (ADL), having been measured Basic Activities of Daily Living (BADL) and Instrumental Activities of Daily Living (IADL), using the scales of Katz et al. (1963)[22] and Lawton and Brody (1969),[23] respectively. They were considered functionally independent elderly when there was no dependence on any of the basic[24] or instrumental activities of daily living,[25] being considered a point for each functioning area performed independently on both scales.

The categorical variables were statistically treated using frequencies and percentages, using Pearson's chi-square test and Fisher's exact test to identify differences between groups of anemic and non-anemic elderly people. For continuous variables, averages, medians and standard deviations were calculated. The Kolmogorov-Smirnov test verified the normality of the data for continuous variables, and in those with normal distribution, the comparison made using the t-test for independent samples and for the non-normal distribution variables, the comparison was performed using the non-parametric Mann-Whitney U test. For the analyses, a 5% statistical significance level was considered. The analyzes were performed using the software named Statistical Package For The Social Science (SPSS), version 21.0.

This study was approved by the Research Ethics Committee from the *Universidade Estadual do Sudoeste da Bahia (UESB)* under the Legal Opinion No. 042.395/2016, *Certificado de Apresentação para Apreciação Ética (CAAE)* [Certificate of Presentation for Ethical Appreciation] No.10786212.3.0000.0055.

RESULTS

The average level of hemoglobin in the population was 13.8 mg/dL (SD=2.60). From the sociodemographic and behavioral characteristics, there was a statistically significant difference for the age group, with the proportion of elderly people over 80 years old (35.3%) being higher among the anemic, when compared to the non-anemic ones. Considering the other sociodemographic and behavioral characteristics, no differences were identified between the groups (**Table 1**).

Table 1 - Distribution of sociodemographic and behavioral characteristics of the elderly subjects according to their condition of anemia. *Aiquara* city, *Bahia* State, Brazil, 2015

Variables	Condition of anemia				p
	Non-anemic		Anemic		
	n	%	n	%	
Gender					**0,066**
Male	103	46,2	10	29,4	
Female	120	53,8	24	70,6	
Age group (years old)					**0,026**
60 – 69	95	42,6	10	29,4	
70 – 79	92	41,3	12	35,3	
≥ 80	36	16,1	12	35,3	
Marital status					**0,764**
Living in a common-law marriage	111	50,2	15	45,5	
Not living in a common-law marriage	54	24,4	10	30,3	
Widow	56	25,3	8	24,2	

Variables	Condition of anemia				p
	Non-anemic		Anemic		
	n	%	n	%	
Skin color					**0,759**
Non-black	41	18,4	7	20,6	
Black	182	81,6	27	79,4	
Education**					**0,645**
Did not attend school/ can read and wright	114	52,5	20	60,6	
Elementary school I and II	92	42,4	12	36,4	
High school/ College	11	5,1	1	3,0	
Individual income (R$)*					**0,259**
≥ 1 minimum wage	116	53,0	14	42,4	
< 1 minimum wage	103	47,0	19	57,6	
Currently drinking					**0,401**
No	175	79,2	24	72,7	
Yes	46	20,8	9	27,3	
Currently smoking**					**0,595**
No	186	89,9	26	86,7	
Yes	21	10,1	4	13,3	

*Minimum wage in 2015 R$ 788.00; **Fisher's exact test.

Concerning the health characteristics, larger proportions of dependents were identified in the group of elderly people bearing anemia, as for performing both BADL (24.2%) and IADL (81.8%), where these differences were considered statistically significant. Regarding the other health characteristics, nutritional status, cognitive status, number of chronic diseases and hospitalizations and presence of parasites in the feces, no differences were found among anemic and non-anemic people (**Table 2**).

Table 2 - Distribution of the characteristics related to the elderly subjects' health status according to their condition of anemia. *Aiquara* city, *Bahia* State, Brazil, 2015

Variables	Condition of anemia				p
	Non-anemic		Anemic		
	n	%	n	%	
Nutritional status					**0,868**
Adequate	39	20,6	5	17,9	
Insufficient	72	38,1	10	35,7	
Overweight	78	41,3	13	46,4	
Cognitive status					**0,248**
No decline	177	79,4	24	70,6	
With decline	46	20,6	10	29,4	
Number of chronic diseases***					**0,084**
None	55	31,4	3	13,6	
One or more	120	68,6	19	86,4	
Number of hospitalizations					**0,153**
None	170	78,0	22	66,7	
One or more	48	22,0	11	33,3	
BADL*					**0,018**
Independent	199	90,0	25	75,8	
Dependent	22	10,0	8	24,2	
IADL**					**0,010**
Independent	92	41,6	6	18,2	
Dependent	129	58,4	27	81,8	
Parasitological stool sample exam					**0,761**
Negative	143	69,4	20	66,7	
Positive	63	30,6	10	33,3	

*BADL - Basic Activities of Daily Living.
**IADL - Instrumental Activities of Daily Living.
***Fisher's exact test.

A statistically significant difference was found in the distribution of the dosage of laboratory tests between the anemic and non-anemic groups, with the average concentrations of urea and creatinine being higher in the anemic elderly, and these had lower concentrations of blood glucose, albumin, GPT, serum calcium and total T_3 (**Table 3**).

Table 3 - Comparison of the laboratory indicators among anemic and non-anemic patients. *Aiquara* city, *Bahia* State, Brazil, 2015

Variables	Total		Condition of anemia				p
			Non-anemic		Anemic		
	Average	DP	Average	DP	Average	DP	
Glycemia (mg/dL)	114,55	51,57	116,90	54,31	99,24	22,80	0,038
Cholesterol total (mg/dL)	211,65	45,94	210,82	45,72	217,1	47,8	0,460[a]
HDL (mg/dL)	48,53	14,43	48,62	14,56	47,93	13,67	0,961
LDL (mg/dL)	133,03	39,76	131,82	38,80	142,64	46,46	0,203
VLDL (mg/dL)	29,40	18,09	29,62	18,05	27,86	18,61	0,544
Triglycerides (mg/dL)	148,07	87,38	148,11	78,42	147,80	133,32	0,390
Uric acid (mg/dL)	4,61	1,55	4,56	1,56	4,97	1,42	0,143
Urea (mg/dL)	32,98	11,33	32,06	9,93	38,78	16,92	0,041
Creatinine (mg/dL)	0,93	0,23	0,90	0,19	1,11	0,36	0,001
Total proteins (g/dL)	7,03	0,61	7,02	0,56	7,06	0,87	0,767
Albumin (g/dL)	4,01	0,30	4,03	0,30	3,88	0,31	0,023

Variables	Total		Condition of anemia				p
			Non-anemic		Anemic		
	Average	DP	Average	DP	Average	DP	
GOT (U/L)	26,26	9,52	26,54	9,63	24,50	8,71	0,248
GPT (U/L)	15,80	10,09	16,41	10,42	11,74	6,34	0,003
GGT (U/L)	44,74	76,40	44,98	78,98	43,24	57,92	0,751
Alkaline phosphatase (U/L)	87,53	43,40	88,47	44,91	81,41	31,72	0,172
Amylase (U/L)	97,02	43,73	97,10	44,60	96,48	38,13	0,641
Serum calcium (mg/dL)	9,42	0,91	9,48	0,93	9,00	0,63	0,002
Total T_3 (ng/mL)	1,40	0,19	1,42	0,18	1,26	0,21	0,000
Free T_4 (ng/mL)	1,16	0,15	1,16	0,14	1,13	0,18	0,604
Total T_4 (ng/mL)	7,27	1,65	7,38	1,59	6,58	1,87	0,102
TSH (µg/dL)	2,08	2,74	1,87	1,32	3,52	6,70	0,819

[a] Student t-test for independent samples. Mann-Whitney U test was performed for the other analyzes.

Glutamic-oxalacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), gamma-glutamyltransferase (GGT), triiodothyronine (total T_3), thyroxine (total and free T_4), thyroid-stimulating hormone (TSH).

DISCUSSION

The results showed a larger proportion of elderly people over 80 years old in the anemic group, which corroborates with the studies that found a higher prevalence of anemia with increasing age,[10-2] mainly among the oldest old.[9]

The higher prevalence of anemia with increasing age has been related to the presence of chronic diseases in this population group, a fact similar to that found in other studies.[2,14] Although there was no association between the number of chronic diseases and hospitalizations in the studied population, it is possible to identify a superior proportion of these events among anemic elderly people. In addition to comorbidities, other factors such as the decline in functional capacity, characterized by impaired activities such as eating, mobilizing,[24] preparing meals and taking medication[25] can compromise the maintenance of physical, mental and nutritional health.

With regard to the functional capacity to perform basic and instrumental activities of daily living, a higher proportion of dependence was found in the group of anemic elderly people. Knowing that anemia may be related to nutritional or deficiency, one can consider the dependence to perform basic and instrumental activities of daily living, such as the preparation and consumption of essential foods and the perception of self-care with aspects of physical and nutritional health as determining factors for the onset of anemia.

A statistically significant difference was found in the values obtained by laboratory tests between the anemic and non-anemic groups, with the average concentrations of urea and creatinine being higher in the anemic elderly and those of blood glucose, albumin, GPT, serum calcium and T_3 being lower.

Among the biochemical tests analyzed, urea has its plasma level dependent on diet, liver function and other diseases, being used to assess kidney function, along with creatinine, which despite being little influenced by diet, the overload of proteins from animal origin can promote elevations.[5] A study carried out in *Bambuí* city (*Minas Gerais* State) found that anemic elderly people had higher average serum creatinine values.[26]

The physiological decrease in glomerular filtration and kidney damage secondary to chronic diseases are common in elderly people, which makes them more susceptible to chronic kidney disease that is related to anemia and is often underdiagnosed and untreated.[3] Among the considered elderly people, it is possible that the presence of any kidney problem has not yet been diagnosed, which is an important aspect of conducting further investigations.

The average blood glucose level was lower in the anemic group. Considering that the majority of anemic elderly people are dependent on BADL and IADL, conditions that can compromise their ability to choose, prepare and consume food, it is possible that such elderly people have insufficient diets, thus reflecting lower average glycemic levels. These findings may suggest that the anemia found in this context is potentially related to the type of deficiency. Nonetheless, this result should be viewed with caution, since the classifications of types of anemia have not been done.

The average values of albumin, GPT, serum calcium and T_3 were lower in the anemic group. A study identified that the average concentration of albumin is lower in anemics with chronic diseases.[2] The reduction in albumin levels can occur in several diseases, such as nephrotic syndrome, advanced liver failure, diabetes, thyrotoxicosis, prolonged febrile states, and massive hemorrhages, in addition to dietary deficiencies.[20] Upon this study's framework, the socioeconomic conditions of elderly people are low, which can lead to dietary deficiencies in the type and amount of food consumed, especially protein intake, which can result in low serum albumin dosages.[20] This inadequate intake of protein content can also affect the functional capacity of elderly people,[27] as seen in the anemic group.

Regarding the measurement of GPT, it showed lower values in the group of anemic elderly people. The activity of the alanine-aminotransferase enzyme is related to hepatocellular integrity[5] and its reduction is described in cases of myocardial infarction in which there is an increase in GOT and a decrease in GPT[20] and in alcoholic liver disease, in which GOT is rarely> 300U/L and the GPT is often normal, with a low serum level of GPT resulting from alcohol-induced pyridoxal phosphate deficiency.[28] The proportion of elderly people who reported alcohol consumption today was higher in the group of anemic, however, there was no statistically significant difference between groups.

The total calcium concentration was lower in the anemic elderly group. Absorption of dietary calcium decreases with advancing age and, moreover, not all forms of dietary calcium are absorbed equally.[29] Low doses of this ion in the group of elderly anemics may be related to dietary aspects, but hypocalcemia can also be resulting from hypoparathyroidism, vitamin D deficiency, kidney failure, adult celiac disease, prolonged use of anticonvulsants, among others.[30] Hence, this result requires caution in interpretation.

The total thyroid hormone T_3 showed a lower average distribution in the anemic group. This hormone is linked to plasma carrier proteins, a deficiency of these proteins causes low levels of this hormone.[31] Furthermore, the conversion of the hormone T_4, which is an important precursor to T_3, can be impaired by fasting, systemic disease and a variety of drugs, including propranolol, amiodarone, and glucocorticoids.[5] It is possible that the lower average total T_3 dosage in the anemic elderly group was caused by the interference of carrier protein levels due to the use of different medications. The investigation of hormonal changes, including the measurement of thyroid hormones, should be considered, especially when the cause of the anemia is not explained, since a normal endocrine function of the thyroid is important to maintain normal erythropoiesis.[32]

The results of this study should be carefully analyzed since the specifications of anemias in elderly people were not implemented, as well as the assessment of food consumption. It is possible that such aspects might add other perspectives in the interpretation of the results obtained, therefore, it is important that studies pursue to contemplate these dimensions when assessing anemia in elderly people.

FINAL CONSIDERATIONS

When comparing the sociodemographic, behavioral and health status characteristics between groups of elderly people either bearing anemia or not, it was found that there are statistically significant differences related to age, dependence on BADL and IADL as well. Considering the laboratory parameters, there were statistically significant differences related to the dosages of urea, creatinine, glycemia, serum calcium, total T_3 and GPT, and in the anemic group, the results were higher in urea and creatinine and lower in the others. Anemia cannot be considered only as a hematological change in the aging process, rather as a result of multiple factors such as sociodemographic, health, diet and living conditions of elderly people.

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