Aspects of the health of Brazilian elderly living in a riverine municipality of Amazon rainforest

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ABSTRACT

Objective: The Amazon region presents a large ethno-cultural and social diversity that can help us to understand the aging phenomenon. Unfortunately, research of gerontology issues in the Amazon is virtually nonexistent. In this context, we implemented the Elderly Rainforest Project (ERP) to investigate gene-environmental variables on aging and age-related diseases in the Amazon rainforest. Here we describe the comparison of health indicators between elderly living in riverbanks (Riverine population, Maués - AM) and elderly in urbanized region (Manaus-AM). **Methods:** a cross-sectional study was performed to compare the health indicators of two elderly populations: Manaus and Maués in subjects selected from Brazilian free public health care

RESUMO

Objetivo: A região Amazônica apresenta uma grande diversidade etno-cultural e social que pode nos ajudar a compreender o fenômeno do envelhecimento. Infelizmente, pesquisas em gerontologia na Amazônia são praticamente inexistentes. Neste contexto, foi implantado o Projeto Idoso da Floresta (Elderly Rainforest Project - ERP) para investigar variáveis genético-ambientais no envelhecimento e doenças relacionadas à idade na floresta amazônica. Neste estudo, descrevemos a comparação dos indicadores de saúde entre idosos vivendo nas márgens dos rios (população ribeirinha) e idosos vivendo em zonas urbanizadas (Manaus - AM). **Métodos:** foi realizado um estudo transversal para comparar os indicadores de saúde de duas populações de idosos: Manaus e Maués, os

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program (ESF-SUS). Manaus was choosing as Amazonas larger urban area. Maués has a large area, and the riverine native habitants live in 175 river villages spread throughout a 39,988-km^2 area along the rivers. The elderly of both populations were probabilistically selected from the Brazilian public health care program. **Results:** The study included 3,314 subjects aged 60 and older (1,805 Riverine and 1,509 Manaus older adults). We observed a greater number of older individuals ($\geq$80 years) and a lower prevalence of obesity, type II diabetes, hypertension, and cardiovascular diseases in the Riverine elderly as compared to the Manaus elderly. **Conclusion:** Despite the poorer socioeconomic profile and reduced access to reliable healthcare for the Riverine elderly as opposed to those who live in Manaus, it seems that the epidemiological profile is not dramatically affected by these conditions. Most likely, lifestyle variables have a beneficial influence on the health of the Riverine elderly.

Key-Words: Rainforest aging, elderly, health community, geriatric morbidities

indivíduos foram selecionados da estratégia de saúde da família (ESF-SUS). Manaus foi escolhida por ter a maior área urbana do Amazonas. O município de Maués possui uma grande área, e os habitantes ribeirinhos nativos vivem em 175 vilarejos ribeirinhos espalhados numa área de 39,988km^2 ao longo dos rios. Os idosos inseridos na Estratégia de Saúde da Família (ESF-SUS) das duas populações foram escolhidos aleatoriamente. **Resultados:** O estudo incluiu 3.314 indivíduos com 60 anos ou mais (1.805 idosos ribeirinhos e 1.509 idosos de Manaus). Observamos um número maior de idosos longevos (>80 anos) e uma menor prevalência de obesidade, diabetes tipo II, hipertensão e doenças cardiovasculares nos idosos ribeirinhos quando comparados aos de Manaus. **Conclusão:** Apesar do perfil socioeconômico mais pobre e reduzido acesso aos cuidados de saúde de confiança dos idosos ribeirinhos, em oposição àqueles que vivem em Manaus, parece que o perfil epidemiológico não é dramaticamente afetados por essas condições. Muito provavelmente, as variáveis do estilo de vida têm uma influência benéfica sobre a saúde dos idosos ribeirinhos.

Palavras-chave: envelhecimento na floresta, idosos, saúde comunitária, morbidades geriátricos

Introduction

According to the Global Burden of Disease, estimates for a large number of elderly people who live in countries or regions with low and middle incomes present a higher prevalence of non-communicable diseases. However, disability and disease in elderly people living in areas with little access to healthcare has not been well studied in the Amazon region of Brazil. Some causes of the incipience of elderly epidemiological studies in this region are related to the geographical and ecological characteristics of the Amazon area.

The Amazon rainforest, with seven million square kilometers, represents the majority of the forested area within Brazil (60%) and over half of the planet's remaining rainforests. This region comprises the largest and most species-rich tract of tropical rainforest in the world. The population of the Amazon River Basin is estimated at approximately 10 million and is mostly concentrated in urban areas along the river and its main tributaries. A high percentage of the population consists of indigenous or admixed communities settled mainly along the banks of the river (riverine or riparian population) (Whitmore , 1998).

Both, indigenous and riverine populations have an intimate knowledge of natural resources, and their use of the forest in general is non-destructive, although they do alter its structure and composition (IBGE, 2011). The socioeconomic, communal and cultural peculiarities that reflect the geographic and historic characteristics of the region have consequences in the clinical-epidemiological aspects of the major prevalent diseases in this area.

For this reason, we consider the Amazon biodiversity and ethno-cultural sociodiversity as a means to help us to understand some human biological processes, including the aging phenomenon. We describe for the first time a study of the general health status (via self-reported data and that obtained from data records of the Public

Health Service) of riverine elderly who live on the banks of rivers and streams in the Maués municipality compared to elderly living in a highly urbanized Amazon region (Manaus).

Methods

Choice of the study population

The study was performed in the Amazonas State, Brazil. Firstly, we performed an analysis to choose the municipality where the study would be performed. From Brazilian demographic government data, we analyzed the age structure of the municipalities over 29 years (1980 to 2009) using the aging index (AI) comparison, which is sometimes referred to as the elder-child ratio. The analysis was made considering the last three governmental census surveys conducted in 1980, 1991 and 2000 and the population estimates provided in the intervening years. We included in the analysis the estimated population for January 2009, at which time the project was implemented. Cities with populations less than 20,000 inhabitants were excluded from the analysis because the proportional number of elderly was very low. In the first analysis, four cities were selected: Manacapuru, Manaus, Maués and Nova Olinda do Norte. All cities presented a relatively higher aging index (> 0.16) compared to others. Since Manaus is a large city (the capital of Amazonas State), we excluded this city as a representative of the riverine population. Another question considered in selecting the study regions was related to the social accessibility of the population to be investigated. Access to participants is one of the main constraints for the development of a cohort study, aside from cost and the loss of participants over time due to refusal, change of address or emigration. These constraints are particularly important in developing countries, where a lack of follow-up resources is typical. Therefore, our choice of the town of Maués-AM was made considering the feasibility of the study in terms of the co-operation of inhabitants and the availability of facilities for follow-up of the participants.

Another important criterion used to choose the city for research in Amazon riverine elderly was related to economic costs in terms of subject accessibility. To access the participants of our research, we developed collaboration with the Family Health Strategy of the Brazilian Unified Health System (ESF-SUS), the Brazilian free public health care program. The ESF-SUS was created to ensure all Brazilians universal, integral, and equal access to health promotion, prevention, treatment and rehabilitation of diseases. The SUS is based on a ranked service network and ensures broad social control through family health teams. Within the context of public social security policies, it has a decentralized structure, with each governmental level having its own management mechanism but acting in an integrated manner (Brazilian National Health System , 2010). Each team of health is comprised of a physician, a nurse, a nursing assistant, and five or six community health workers. The ESF-SUS is implemented in 62 cities of Amazonas State, including 498 boards of health and 6.083 health communitarian agents. In the city of Maués, 92% of the population is under the care of the ESF-SUS Program. During the study period (2009), Maués had an elderly population of 6.43%. The frequency of elderly > 80 years old was 1%, whereas in Manaus and many other Amazonas cities, this frequency was lower (0.5%) (IBGE, 2011).

Maués Baseline Characteristics

Maués is geographically located in the middle of the Amazon region (Figure 1), was founded in 1798 by Portuguese people and, in 1896, became a municipality. Maués's headquarters is located on the right bank of the Maués-Açu River (Table 1). The primary agricultural resource of Maués is guaraná (*Paullinia cupana*), the production of which was initially established by the native Sateré-Maués people who now live in a native indigenous reservation located in Maués city.

Besides the Sateré-Maués natives who first colonized area, the region is currently inhabited by riverine people named Caboclos. The Amazonian "non-urban" societies can to be categorized in three groups: indigenous

societies, traditional farmers and caboclos (Adams, 2006) Caboclos are a Portuguese-speaking mestizo people thought of as a 'quasi-ethnic' group and recognized as the historical peasantry of the Amazon (Antoinnete, 2006). The group known as peasants is defined in a variety of ways and in the Brazilian Amazon 'peasants and peasantry are inherently problematic terms. The Caboclo culture can be traced back about 300 years, originating as a disenfranchised Native Amerindian population. This group occupied the depopulated floodplains after the ravages of disease brought on by the arrival of Europeans. The native peoples mixed with European settlers, primarily Portuguese, and adopted a form of social organization that reflected their Amerindian and European ancestors (Krieger et al., 1965). Locally, Caboclos are referred to as ribeirinhos (riverine, river-side dwellers). Genetically, the Caboclos living in Maués probably have a similar ethnic contribution, as described by Ferreira et al. (2002) to other western riverine Amazonian populations.
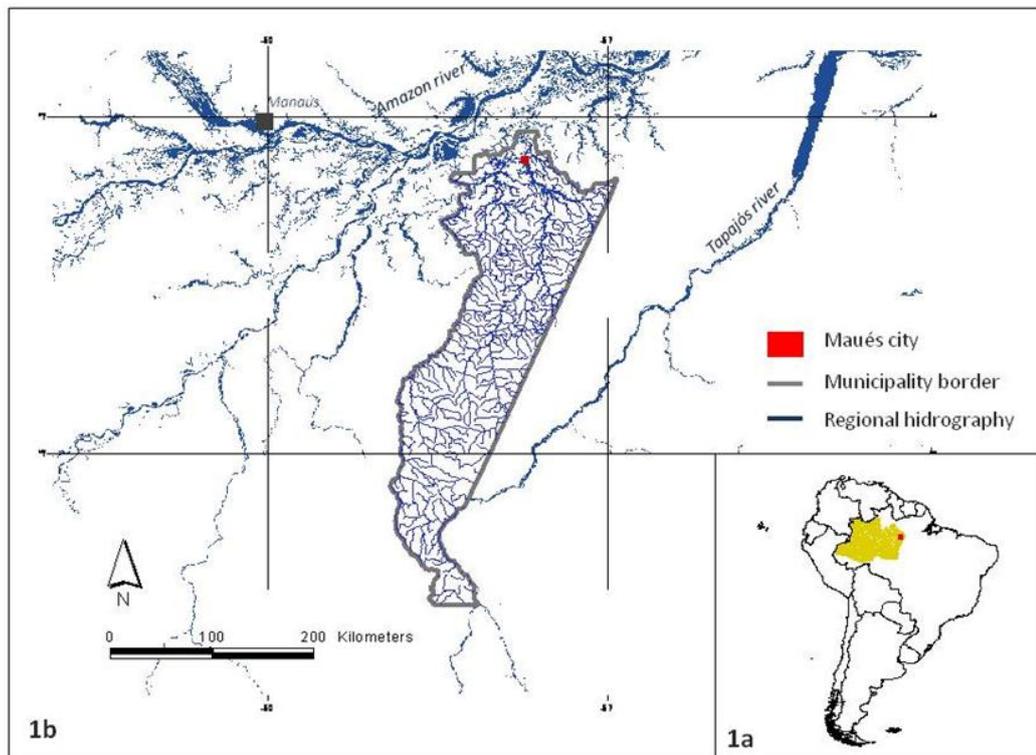
Figure 1. Maués, Amazonas- Brazil. 1a- Maués geographic localization in Brazil and Latin America. 1b - Maués map highlighting the hydrography (rivers) that compose the municipality where they are scattered coastal communities where the elderly reside here investigated.

The contributions of Amerindians, Europeans and Africans to the ethnic composition of the studied populations were 0.44± 0.064, 0.35± 0.069 and 0.21±0.046 frequencies, respectively.

Manaus baseline characteristics

To perform this study we compared the Maués elderly with a Manaus sample population that was previously investigated by Ribeiro and collaborators (2008) Briefly, was performed a two-stage epidemiologic study conducted as follows: (1st) selection of basic health units (UBS) as unit selection; (2nd) elderly selection as randomized sample unit from each UBS. From Municipal Health Secretariat in 2009 there are 171 ESF-SUS teams in Manaus covering 41% population. In this period, there were 675.105 peoples in Manaus including 33.080 elderly with ≥ 60 years old. In the moment of the study just 169 health units were working. In the first stage the ESF-SUS health units were selected as the basic unit selection. These units are distributed in four Manaus

geographic regions. As described in Maués the health agents were choose as the "early unit selection". In the second stage, the elderly was considered as amostral unit and was randomly chosen from the families' attendant by each health agent. All data were collect in the elderly residence.

Community approach and ethical issues

The investigation strategy to approach the community and to perform the first analysis of the Maués elderly population was comprised of the following steps (1) We contacted the Municipal Health Department of Maués and the ESF-SUS Amazonas State for organization of research (2) An anthropological pilot study of the health and social characteristics of the Maués elderly was performed to organize the structured interview according to the linguistic and cultural structure of that region, which differs from that of southern and southeastern Brazilian regions (subjects from both urban and riverine-rural regions were interviewed) (3) We validated a structured interview by the application of the survey to 100 seniors participating in the Elderly Community Centre of Maués (4) Health communitarian ESF-SUS workers were trained to apply the research instrument. At the time of the study, there were 154 trained health workers. The training was coordinated by a nurse professional who was a specialist in gerontology (5); The structured interview was implemented and applied by the health team (6); Data were collected and analyzed. The project was approved by the Ethical Committee of the Universidade do Estado do Amazonas (Process number: 807/04). Since the vast majority of older people were illiterate, oral consent or fingerprinting was obtained for their participation in the study after the consent form was read to each participant by the researchers.

Study design and baseline survey questionnaire

The baseline survey questionnaire consisted of general and simplified questions to gather self-reported data from the elderly, including (1) social and demographic characteristics; (2) self-reported health conditions including the presence of hypertension, type 2 diabetes mellitus, obesity, coronary diseases, stroke, cancer and rheumatic diseases; (3) annual immunizations; (4) and falls and fractures within the past six months. The health data self-report approach has been well documented as a reliable predictor of functional disability and mortality in aged populations (Sun et al., 2007).

The interviews lasted about 90 minutes and were carried out in the participants' homes. Each interview was completed in one or two visits (within a one-week period) depending on the respondent's need for rest. When a respondent was unable to participate because of cognitive deficit or for some other health or social reason, an appropriate proxy was used. Proxies were identified in relation to age, gender, schooling and relationship to respondent. They were not asked questions that required personal judgments, such as psychosocial well-being and mental health.

Since Manaus is a very large city, the elderly socioeconomic, cultural and health status variables were compared with those of elderly selected from a two-stage epidemiologic study conducted as follows: (1) selection of basic health units (UBS) as unit selection; and (2) elderly selection as randomized sample units from each UBS. We chose to use the elderly living in Manaus, Amazonas, because previous population studies indicated that these elderly have an epidemiological profile similar to that of both developing countries and developed countries (Roriz-Cruz et al., 2008).

Analysis of indicators of credibility of self-reported information

As we did not find any previously reported studies with similar approaches in the riverine elderly, and the socioeconomic and cultural (educational) conditions of this population are very low, a complementary investigation was performed to assess whether if the self-reported health information was accurate. We asked that elderly self-report the occurrence of hospitalizations within the past year as well as the main cause of each hospital stay. Furthermore, we analyzed the correlation between the self-reported information and the information available both from Maués hospitals and official data from the Ministry of Health. The responses of

the elderly concerning the main causes of hospitalization were analyzed and grouped by International Statistical Classification of Diseases and Health Related Problems – ICD-10 (WHO,2010). The methodology used was similar to that described by Barber et al (2010).

Statistical analysis

All analyses were completed using the statistical package for social studies (SPSS) version 17.0 (SPSS Inc., Chicago, IL). Chi-squared tests and *t*-tests were conducted to examine differences in the sociodemographic and clinical characteristics of the Maués and Manaus elderly groups. Multivariate logistic regression analysis (Backward Wald method) was used to investigate the adjusted odds of having any disability and/or specific chronic diseases, adjusting for sex and age. All variables that showed univariate statistical significance were included in the logistic regression test. All significance levels were two-tailed. The self-reported causes of hospitalization and medical record data were correlated using Spearman's rho non-parametric correlation. The alpha value considered was p$\leq$ 0.05.

Results

The sample consisted of 3,314 subjects aged 60 and older, with 1,805 riverine (male/female= 937/869) and 1,509 Manaus (male/female= 698/807) elderly participants. The riverine elderly studied here represented 61% of Maués elderly population. Baseline characteristic comparisons for the two populations are presented in Table 2.

The mean age of the riverine older adults was 72.9$\pm$8.6 years old, and the mean age of the Manaus older adults was 71.9$\pm$7.8 (p=0.03). We observed a higher prevalence of older individuals (n=331, 18.1%) in Maués compared to than Manaus (n=218, 14.5%) (p=0.004). A lower level of migration from Maués compared to Manaus was found because 1,359 subjects enrolled in the study were born in Maués (75.3%) or neighboring cities (n=347, 19.2), representing 94.5% of sample. The prevalence of married individuals was higher in Manaus than Maués, whereas the rate of illiteracy in the elderly was higher in Maués.

The prevalence of diseases was compared between the two elderly groups, and the data are shown in Table 3. Males and females riverine subjects presented lower prevalence of hypertension, type 2 diabetes, obesity, rheumatism, neoplasia and coronary diseases than elderly living in Manaus. The stroke prevalence was similar between females living in Maués and Manaus.

However, the riverine elderly presented a higher prevalence of falls and fractures than elderly in the urbanized area. The prevalence of falls was also compared between riverine elderly living near Maués headquarters and those in rural riverine communities, but no significant difference was observed between these riverine groups (p=0.618).

From these results, considering that falls and fractures have an important impact on the health and autonomy of older adults, a multivariate complementary analysis was performed to compare the elderly with and without a history of falls and fractures. As shown in Table 4, the causes associated with falls and fractures were different between the elderly populations. The riverine elderly presented a significant association between falls and ages $\geq$ 75 years old and obesity (> 30 kg/m^2). The elderly living in Manaus presented a significant association between falls and gender (females presented more risk to fall than males) as well as stroke.

As we observed a higher number of older individuals (≥80 years old) in the Maués population, an additional analysis was performed to compare the health statuses of these individuals between the two elderly samples investigated here. The only difference observed between older and younger elderly from Maués was the prevalence of obesity. The older elderly presented a lower prevalence of

obesity (n=13, 3.9%) than younger elderly (n=108, 7.3%) (p=0.026). Other variables were similar between age groups in the Maués sample. The older elderly living in Manaus presented similar prevalence of morbidities compared to the younger elderly.

The health status comparison between the older elderly living in Maués and Manaus showed a higher prevalence of diabetes (p<0.0001), obesity (p<0.0001), stroke (p=0.005), coronary diseases (p<0.0001) and rheumatism (p=0.005) in the older elderly from Manaus.

In Maués, 157 elderly reported hospitalization within the past year, and 140 (87%) also reported the main cause of the hospital stay. The remaining 17 did not answer or said they did not know the cause of hospitalization. The cause of hospitalization was used to check the credibility of the self-reported health information.

The Table 5 shows the comparison between cause of hospitalization self-reported by elderly and hospital medical records. From official medical records data the hospitalization of five elderly were classified according to the ICD, Chapter XV (symptoms, signs and abnormal clinical and laboratory findings, not classified elsewhere). Therefore, only 12 (7.6%) elderly did not truly know the cause of their hospital stay.

We found a significant and strong correlation between hospitalization causes self-reported by elderly and the hospitalization causes as described in medical records (r^2= 0.89, p=0.001).

However, we observed that this correlation varied according to the group of diseases. One elderly individual was hospitalized for anemia, which is a disease classified in Chapter III (diseases of the blood and blood-forming organs). This individual also reported causes of certain disorders involving the immune mechanisms.

Six elderly individuals were hospitalized for diabetes mellitus complications (Chapter IV - endocrine, nutritional and metabolic diseases) and reported diabetes to be the main causes of the hospitalization. All elderly hospitalized for external causes (Chapter XIX - injury, poisoning and certain other consequences of external causes) reported this fact. In this case, three elderly reported snakebite, five subjects reported falls, and four reported having suffered some kind of accident. The elderly who were hospitalized due to by diseases of the digestive system (ICD, Chapter XI) also correctly reported this condition.

However, we observed some level of elderly confusion when reporting if the cause of hospitalization was for infectious or respiratory diseases. Medical records showed 8 hospitalizations for diseases grouped in Chapter I, certain infectious and parasitic diseases, and 40 hospitalizations for diseases grouped in Chapter X, - diseases of the respiratory system. In this last group, only 65% elderly gave information that allowed the classification of hospitalization for respiratory problems. It is important to mention that two elderly people were diagnosed with malaria, but no one reported this disease as a cause of hospitalization. Regarding respiratory problems, 98% of elderly presented pneumonia. Hospitalization for diseases of the skin and subcutaneous tissues (Chapter XII) was also difficult to recognize (from seven elderly hospitalized, just two elderly reported the cause correctly) to allow inclusion of these cases in the skin diseases group.

Table 1 Maués, Amazonas-Brazil demographic, socialeconomics, cultural and health indicators

Indicators				
Geographic location	Latitude: -3,38361 Longitude: -57,71861			
Area	39988 Km2			
Population (Governmental Census)	1991	1996	2000	2009*
	30.499	36.527	40.036	45.284
Climate	Tropical hot and humid			
	Min= 22.6^{o}C Max=31.3^{o}C**Media=26.9^{o}C			
	Humidity= 81%			
Acess	Access: rain and air transport			
Distance from Manaus	356 km (rain transport)			
Population distribution (2009)	Urban riverine region: 21.094			
	Rural riverine: 24.190			
Riverine population geographic distribution	175 communities distributed in river affluents			
Population distribution by ESF-SUS Health Units in urban and riverine-rural areas **	Population	Elderly population	Elderly proportion (%)	
Maués Açu 1	1662	85	5.11	
Limão Grande 1	1110	63	5.68	
Pupunhal	907	53	5.84	
Parauari II	1902	112	5.89	
Maués Miri IV	2224	146	6.56	
Castanhal Baixo V	1679	102	6.20	
Médio Acocuitaua	1853	80	4.32	
Apocuiatua Grande VII	1744	73	4.20	
Parana do Uruariá de Cima VIII	1760	88	5.00	
Parucuni IX	1474	155	10.5	
Lago Grande da Barreira X	1419	69	4.86	
Urupadi XI	1388	60	4.32	
Apocuiatua Miri XII	1972	101	5.12	
Unidade Mista	4245	369	8.69	
Centro de Saúde II	3206	348	10.85	
Ramalho Junior	4107	355	8.64	
Jorge Brito	4565	237	5.19	
Santa Luzia	4822	269	5.58	
Mário Fonseca	3245	174	5.36	
Total	45.284	2.939	6.43	
Demographic density			1 hab/Km^2	
Life expectance in the birth***			68.3 years	
Infant mortality***			35.3/1000 live births	
HDI			0.689	
Health coverage (ESF-SUS)			92% of the population	

* Maués population in January inserted in ESF-SUS ** = Data from ESF-SUS, Maués-Amazonas, Brazil; *** = Census 2000; HDI= human development index; ** Means of temperature (minimum and maximum) calculated from 1961 to 1990 period.

Table 2 Sociodemographic Characteristics of Amazonas's Older Adults that lives in Riverine area (Maués) and an industrialized area (Manaus), Brazil.

		Riverine Region n= 1805	Industrialized Region n= 1509	p
Characteristic				
Age	60 -64	449 (24.9)	273 (18.1)	<0.001
	65-74	666 (36.9)	728 (48.2)	
	74-84	505 (28.0)	403 (26.7)	
	> 85	185 (10.2)	105 (7.0)	
Local of Birth	Maués/ Manaus	1359 (75.3)	896 (59.4)	< 0.001
Marital status	Married	885 (49.0)	841 (55.9)	0.001
	Other	920 (51.0)	664 (44.1)	
Level of education	Illiterate*	1283 (71.1)	750 (49.7)	<0.001
	≥12 years	99 (5.5)	107 (7.1)	
Own financial income		1040 (57.6)	641 (42.4)	< 0.001

* Elderly that did not know to read and write and elderly that Just sign their names

Table 3 Prevalence morbidities comparison between Amazon' elderly that lives in urbanized and industrialized area (Manaus-AM) and in Riverine communities (in Maués-AM).

Morbidities	Maués	Manaus	p
	N (%)	N (%)	
Hipertension	692 (38,3)	857 (57,1)	<0,0001
Diabetes	144 (8,0)	375 (25,0)	<0,0001
Obesity	121 (6,7)	276 (18,6)	<0,0001
Fall in last 6 months	430 (23,8)	281 (18,7)	<0,0001
Fractures falls-associated	83 (19,3)	32 (11,4)	0,005
Stroke	63 (3,5)	81 (5,4)	0,007
Coronary diseases	18 (1,0)	176 (11,7)	<0.0001
Reumatism	464 (25,7)	312 (48,5)	<0,0001
Neoplasia	27 (1,4)	37 (2,5)	0,001
Hospitalization in last year	157 (8,6)	248 (16,6)	< 0,0001
Infectious and parasitic diseases	404 (22,4)	144 (8,2)	<0,0001
Influenza immunization in last year	873 (48,3)	1103 (73,5)	<0,0001

*Tropical impaludism (malaria) and/or dengue and/or leshimaniose

Diseases of the circulatory system (Chapter IX) were responsible for 19 hospitalizations, and all elderly answered correctly concerning the causes of their hospital stays. However, the specific cardiovascular problem was not identified by all elderly. In general, we observed some confusion between hypertension and heart failure. Diseases of the genitourinary system (Chapter XIV) were the cause of hospitalization for 19 subjects. However, 42% gave information that allowed us to recognize these as genitourinary diseases.

When asked about the cause of hospitalization, some reported only vague symptoms or procedures. Thus, 12 elderly people reported having undergone surgery, and 9 reported symptoms such as fainting, dizziness, sore

and vision problem, among others. The correlation between the causes of hospitalization self-reported by the elderly and described in medical records were independent of sex and age.

Table 4 Multivariate analysis of factors associated to fall self-report in Riverine elderly (Maués) and Urbanized elderly (Manaus) that lives in Amazonas, Brazil.

Variables	Riverine elderly Maués	Urbanized elderly Manaus
	OR (CI95%)	OR (CI95%)
Sex (Women)	1,042 (0,98-1,09)	1,07 (1,03-1,13)
Age (≥ 75 years old)	1,32 (1,06-1,66)	1,01(0,76-1,34)
Hypertension	1,20 (0,96-1,49)	1,14 (0,87-1,48)
Diabetes type 2	1,03 (0,69-1,53)	0,95 (0,70-1,28)
Obesity	1,51 (1,01-2,25)	1,09 (0,78-1,52)
Stroke	0,83 (0,44-1,53)	1,78 (1,08-2,95)
Coronary disease	1,60 (0,60-4,31)	1,08 (0,73-1,65)
Rheumatism	1,21 (0,95-1,54)	0,97 (0,65-1,44)
Other diseases	1,45 (1,15-1,84)	1,33 (1,31-1,76)

Discussion

We describe here the general health status of elderly living in riverine communities in the from Amazon rainforest compared to the health status of elderly that lives in an urbanized area. This study required a great effort given the difficulties of geographic access to populations of the Amazon rainforest. However, we believe that the study is relevant to understanding the aging process in native conditions observed in isolated or semi-isolated populations such as the Amazon rainforest.

From the results obtained, some questions need to be discussed. The first of these is related to the fact that a higher number of older elderly was found in the riverine population compared to the Manaus. To interpret these findings, it is important to note that the process of human demographic transition in Brazil is complex and presents differences among Brazilian's regions (Carvalho and Wong, 1998; PAHO, 2004). The greater number of older elderly observed in Maués could to be interpreted simply as a demographic process specifically related to migration patterns.

Previous studies have described that rural urban migration at younger age contributes to faster aging in rural Brazilian areas and slower aging in urban areas. Historically, a large number of people from rural Amazon areas and other Brazilian areas have migrated in the last 60 years to Manaus searching for jobs and other opportunities (Murrieta, 2001). Currently, the main Manaus industrial economy is part of the second largest metropolitan area in the Northern Brazil and the twelfth in all of Brazil. As the industrial sector is the largest component of the economy and attracts many workers each year, the constant immigration could be influencing the proportion of elderly people compared to Maués (Denslow, 1988). The constant influx of workers to Manaus could change the proportion of elderly, thereby decreasing the number of older elderly. However, the analysis of age distribution considering all cities of Amazonas found few cities with approximately 1% older elderly individuals (≥80 years old), as is the case in Maués city. Most counties have approximately 0.5% of older elderly, including Manaus. Additionally, a large number of elderly investigated here was reported to be born in Maués or neighboring municipalities. For this reason, we cannot exclude the possibility that it is a

phenomenon that goes beyond the demographic questions of migration. However, we need to have caution with question since if it is the trues, Maués Riverine elderly cannot be considered representative of other regions of the Amazon river.

The possible existence of other intervenient variables that act on riverine lifespan and health is also reinforced by the observed lower prevalence of chronic diseases in the riverine elderly compared to that in the older people of Manaus. These data concerning the health status of the riverine elderly could be considered surprising since because the socioeconomic and cultural conditions of these are of poorer quality than those of the urban elderly investigated here. The literature from developed countries has consistently demonstrated that elderly with lower socioeconomic positions are more likely to suffer from both morbidity and mortality than elderly living in best conditions (Ho et al., 2009; Hoang et al., 2010; Mackenbach et al.,1997).

However, the same situation is not clear in developing countries because some studies have shown inconsistent findings on the effects of socioeconomic status and education on health indicators (Subramanian et al., 2005).

One factor to explain the lower prevalence of chronic diseases could be the lack of access to the health system to perform diagnosis and treatment of diseases for the riverine elderly. However, the Maués area is covered by the Brazilian health service, and some diagnoses were possible to obtain, allowing for the comparison of health indicators between the two populations. Therefore, we do not believe that the accessibility could have a large contribution in explaining the differences in disease prevalence observed between the riverine and urban elderly (Applegate et al., 1990).

The other question related to the lower prevalence of diseases found in the riverine elderly could to be related to the lack knowledge concerning the riverine elderly and their health states and, consequently, the lack of reporting these morbidities. For this reason we performed an additional analysis using hospitalized elderly to investigate the concordance between the hospitalization cause self-perceived by the elderly and that described in the medical records. The data indicated a strong association between self-reported information and physician diagnosis, suggesting that the use of the self-report approach is valid to investigate the riverine population. These data corroborated early and recent longitudinal studies that support the predictive ability of self-perceived health status in elderly populations (Quesnel-Vallée, 2007). Therefore, we believe that the riverine elderly self-reported diseases were accurate.

In this context, the low prevalence in the riverine elderly of some morbidities, such as obesity, hypertension and type II diabetes, should be noted. It is likely that some environmental, cultural and lifestyle factors are influencing the better health profile of the riverine elderly compared to that of urbanized elderly living in Manaus. Among these factors, diet and daily energy expenditure could to be cited as relevant variables. As this study did not investigate the diet and physical activity patterns of the riverine elderly, it is important to investigate in more detail the environmental and social context of the river banks communities.

Amazonian groups inhabiting low lying forested regions along rivers have a diet based mainly on bitter cassava (*Manihot esculenta*) prepared as bread (casabe or beiju) or meal (farina or mañoco) and fish with high-quality protein **(Erro! Indicador não definido.** (Krieger et al., 1965)). A study performed by Rodrigues et al.(2009) monitored the nutritional status from of 13 riverine communities situated on the banks of the Tapajós Amazon region and suggested that the Amazonian nutritional profile could have possible protective effects on health. A large portion of the foods consumed by the riverine elderly, such as cassava, are obtained through subsistence agriculture and fishing. Additionally, the local population supplements its diet with fruit and seasonal vegetables. The riverine populations studied here have a regional food diet that could improve individual health. For example, in the Maués population analyzed here, the plant *Paullinia cupana* (guarana) was domesticated by the Satere-Maués indigenous people. Guarana is a rainforest vine that has long been used a tonic and to treat various disorders in Brazil. Several studies have investigated the functional and pharmacological properties of guaraná and have described antioxidant (Mattei et al., 1998), antibacterial (Basile et al., 2005), antimutagenic, anticarcinogenesis (Fukumasu et al., 2010), and anti-platelet activities of this vine (Ravi et al., 2008). Additional

studies on human volunteers suggested that guaraná ingestion could also have anti-obesity proprieties (Boozer et al., 2001) and improve cognitive performance and mental fatigue (Kennedy et al., 2008). The daily high intake of guaraná is a cultural norm for the riverine elderly living in Maués.

For this reason, our research team performed a recent study to evaluate the associations of metabolic disorders and anthropometric and biochemical biomarkers of lipid, glucose and oxidative metabolism and the habitual ingestion of guaraná by an Maués elderly sample. Krewer and collaborators (2011) performed a case-controlled study that included 637 elderly based upon their self-reported intake of guaraná. Indeed, the prevalence of various metabolic disorders was associated with guaraná ingestion. The prevalence of hypertension, obesity and metabolic syndrome was lower in the elderly that reported habitual guaraná ingestion. Additionally, these elderly present several biomarkers related to metabolic disorders as well as oxidative metabolism better than elderly that not drink guaraná in their daily life. The results constitute the first epidemiological study to suggest a potentially protective effect of habitual guaraná ingestion against metabolic disorders in elderly subjects.

Because transport is mainly accomplished by river boat or walking (in communities) and the use of other types of transport are restricted, these conditions may contribute to the low prevalence of metabolic morbidities in the riverine elderly observed in this study. Thus, further analysis of functional fitness indicators should be conducted in the riverside population. We believe that studies on functional fitness variables of the riverine older adults will also serve to elucidate if the high prevalence of falls and fractures observed in the elderly studied here is associated with geographical relief of communities and boat transport or with geriatric morbidities that decrease mobility, such as sarcopenia.

Additionally, it is important to comment that the study described here had some methodological limitations. This is a cross-sectional investigation, and therefore, it is not possible to establish a cause-effect association. Data from important variables such as cognitive abilities, depression and the autonomy of the riverine elderly, which could also influence health status, were not obtained. However, we chose to not collect this information because we are not sure how these issues would be interpreted by the elderly and the caregivers. The environmental and cultural conditions of the riverine communities are different of other urbanized populations.

If tests of autonomy such as Katz and Barthel scales were to be applied, the conditions under which daily tasks like dressing and preparing food are performed would be assumed similar to other populations. Unfortunately this is not the reality of the riverine communities. For example, when we ask if an elderly can bathe alone, we are assuming that this elderly individual has a house with one bathroom and that means he will go to the bathroom, undress and bath re-dressing. For those in the forest, this condition means leaving the house alone to go to the river, entering the river, bathing and return to the home usually by a very steep, rugged path. For this reason, the analysis of indicators of independence becomes more complex.

Two other methodological limitation need to be commented. One limitations concerns the criteria for choosing the population in Manaus and Maués that was based on ESF-SUS units of health that difficult to identify the elderly that lives in Manaus's periphery region. In Maués it is much ease since there are a there is a clear distribution between urban and rural areas. In these terms, if Maués elderly present similarities with elderlies that lives in the Manaus periphery is a open question that need to be investigated from complementary study.

The second limitation is related to socioeconomic and cultural conditions that were apparently worse in Maués than Manaus. It is expected that the elderly represent a fraction of the population that suffers from a loss of intellectual ability due to their age condition. We did not evaluate the cognitive state of elderly participants of this study. Therefore we can affirm with accuracy if the information were realistic. However, as we found a good agreement between the information gathered from the illiterate and that obtained from hospital records we believe that these information are closed to reality.

In conclusion, we have shown differences in the health status of the riverine elderly living in the Amazonia rainforest that indicate different epidemiological patterns compared to the urbanized elderly living in the same

Amazonia region. Whether ethno-cultural, environmental and lifestyle aspects contribute to the lower prevalence of chronic diseases observed in the riverine elderly is a question that can only be elucidated through a longitudinal study and complementary investigations concerning the variables of genetics, nutrition, physical activity, and psychology.

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