

Cluster analysis of risk factors for chronic non-communicable diseases in elderly Brazilians: population-based cross-sectional studies in a rural town

Análise por conglomerado de fatores de risco para doenças crônicas não transmissíveis em idosos brasileiros: estudos transversais de base populacional em uma cidade rural

Análisis de conglomerados de factores de riesgo de enfermedades crónicas no transmisibles en ancianos brasileños: estudios transversales basados en la población en una ciudad rural

Received: 12/01/2021 | Reviewed: 12/06/2021 | Accept: 12/11/2021 | Published: 12/20/2021

Saulo Vasconcelos Rocha

ORCID: <https://orcid.org/0000-0001-8655-5151>
State University of Southwest Bahia, Brazil
E-mail: svrocha@uesb.edu.br

Sabrina Correia de Oliveira

ORCID: <https://orcid.org/0000-0002-9044-7943>
State University of Southwest Bahia, Brazil
E-mail: sabrina.correiaoliv.so@gmail.com

Hector Luiz Rodrigues Munaro

ORCID: <https://orcid.org/0000-0002-6421-1718>
State University of Southwest Bahia, Brazil
E-mail: hlmunaro@uesb.edu.br

Camila Fabiana Rossi Squarcini

ORCID: <https://orcid.org/0000-0002-1605-4834>
State University of Southwest Bahia, Brazil
E-mail: cfrsquarcini@uesc.br

Bruna Maria Palotino Ferreira

ORCID: <https://orcid.org/0000-0002-8368-1459>
State University of Ponta Grossa, Brazil
E-mail: brunapalotino12@gmail.com

Felipe de Oliveira Mendonça

ORCID: <https://orcid.org/0000-0003-4139-2656>
State University of Ponta Grossa, Brazil
E-mail: felipeoliveiramendonca@gmail.com

Clarice Alves dos Santos

ORCID: <https://orcid.org/0000-0002-2730-5117>
State University of Southwest Bahia, Brazil
E-mail: casantos@uesb.edu.br

Abstract

Negative health behaviors incorporated into lifestyle are considered the main risk factors for chronic non-communicable diseases (NCDs) in adults and the elderly. However, the relationship between the aggregation of these factors and the sociodemographic conditions of the elderly needs to be better elucidated. The aim of this study was to analyze the simultaneity of the five risk factors for NCDs in the elderly with low economic status living in a rural city in Brazil, and their association with sociodemographic variables. Cross-sectional study was conducted with elderly people from Family Health Units of the city of Ibicui-Bahia, Brazil, where 310 elderly were enrolled. Rates of physical inactivity in leisure (PIL), alcohol consumption, sedentary behavior, overweight/obesity and tobacco consumption were collected through a questionnaire in an individual interview. The average age among participants was 71.62 (\pm 8.16) years. The group presenting the five behaviors had high scores in both sexes (men O/E = 242.5; women O/E = 161.7). Among men and women, the highest scores found through clustering of simultaneous NCD risk factors were for the consumption of alcohol with smoking, and physical inactivity with smoking. When analyzing the association between groups and sociodemographic characteristics, men were more physically inactive than women (OR = 0.96, CI = 0.92-0.98) and concomitantly had unhealthy habits (smoking). In conclusion, the elderly are exposed to health risk factors for concurrent CNCDs and the accumulation of these risk factors was not associated with sociodemographic variables, it is suggested that further studies be carried out with the prevalent variables as well as to analyze why the elderly population presents these levels.

Keywords: Aged; Cluster analyses; Epidemiology; Health behavior; Risk factors.

Resumo

Os comportamentos negativos de saúde incorporados ao estilo de vida são considerados os principais fatores de risco para doenças crônicas não transmissíveis (DCNT) em adultos e idosos. Porém, a relação entre a agregação desses fatores e as condições sociodemográficas dos idosos precisa ser mais bem elucidada. O objetivo do estudo foi analisar a simultaneidade de cinco fatores de risco para DCNT em idosos de baixa condição econômica residentes em uma cidade rural do Brasil, e analisar sua associação com variáveis sociodemográficas. Trata-se de um estudo transversal realizado com idosos de Unidades de Saúde da Família do município de Ibicuí-Bahia, Brasil, onde 310 idosos foram selecionados. As taxas de inatividade física no lazer (PIL), consumo de álcool, comportamento sedentário, sobrepeso / obesidade e consumo de tabaco foram coletados por meio de questionário em entrevista individual. A idade média dos participantes foi de 71,62 (\pm 8,16) anos. O grupo que apresentou os cinco comportamentos teve alta pontuação em ambos os sexos (homens O/E = 242,5; mulheres O/E = 161,7). Entre homens e mulheres, as pontuações mais altas encontradas por meio do agrupamento dos fatores de risco para DCNT simultâneos foram o consumo de álcool com o fumo e a inatividade física com o fumo. Ao analisar a associação entre grupos e características sociodemográficas, os homens eram mais inativos fisicamente do que as mulheres (OR = 0,96, IC = 0,92-0,98) e concomitantemente possuíam hábitos não saudáveis (tabagismo). Como conclusão, os idosos estão expostos a fatores de risco à saúde de DCNT simultâneos e o acúmulo desses fatores de risco não se associou às variáveis sociodemográficas, sugere-se que novos estudos sejam feitos com as variáveis prevalentes bem como analisar o porquê de a população idosa apresentar estes níveis.

Palavras-chave: Análise por conglomerados; Comportamento de saúde; Epidemiologia; Fatores de risco; Idoso.

Resumen

Los comportamientos de salud negativos incorporados al estilo de vida se consideran los principales factores de riesgo de las enfermedades crónicas no transmisibles (ENT) en adultos y ancianos. Sin embargo, es necesario dilucidar mejor la relación entre la agregación de estos factores y las condiciones sociodemográficas de las personas mayores. El objetivo de este estudio fue analizar la simultaneidad de los cinco factores de riesgo de ENT en ancianos de bajo nivel económico residentes en una ciudad rural de Brasil y su asociación con variables sociodemográficas. Se realizó un estudio transversal con ancianos de las Unidades de Salud de la Familia de la ciudad de Ibicuí-Bahía, Brasil, donde se inscribieron 310 ancianos. Se recogieron tasas de inactividad física en el tiempo libre (PIL), consumo de alcohol, comportamiento sedentario, sobrepeso / obesidad y consumo de tabaco mediante un cuestionario en entrevista individual. La edad promedio de los participantes fue de 71,62 (\pm 8,16) años. El grupo que presentó las cinco conductas tuvo puntuaciones altas en ambos sexos (hombres O / E = 242.5; mujeres O / E = 161.7). Entre hombres y mujeres, las puntuaciones más altas encontradas mediante la agrupación de factores de riesgo de ENT simultáneos fueron para el consumo de alcohol con el tabaquismo y la inactividad física con el tabaquismo. Al analizar la asociación entre grupos y características sociodemográficas, los hombres eran más inactivos físicamente que las mujeres (OR = 0,96, IC = 0,92-0,98) y concomitantemente tenían hábitos poco saludables (tabaquismo). En conclusión, los ancianos están expuestos a factores de riesgo para la salud por ECNT concurrentes y la acumulación de estos factores de riesgo no se asoció con variables sociodemográficas, se sugiere que se realicen más estudios con las variables prevalentes así como analizar por qué la población anciana presenta estos niveles.

Palabras clave: Anciano; Análisis de conglomerados; Epidemiología; Comportamiento de salud; Factores de riesgo; Anciano.

1. Introduction

The human aging has been a historically pronounced worldwide trend. Approximately 22% of the elderly population has increased in recent decades worldwide (Bloom *et al.*, 2015). Although, in Brazil, the trend is for a faster demographic aging when compared to world projections, assuming an aging growth of 252% in 2020 compared to 2010 data (United Nations, 2015; IBGE, 2018). Although aging is common in the population, it is still challenging to distinguish cases of chronic non-communicable diseases (NCDs) in this population.

It is known that NCDs are varied (cancer, diabetes, cardiovascular diseases, chronic respiratory diseases, etc.) they are the main cause of death worldwide (Williams *et al.*, 2018). Numerous characteristics, such as being 70 years of age or older and residing in low- and middle-income countries, lead to the risk of death (Bennett, *et al.*, 2018). Moreover, some strategies to prevent and control NCDs are under development to understand the etiology of these diseases, such as investing some countries in preventing NCDs and obtaining economic and social returns (Bertram *et al.*, 2018), on the other hand, actions are used to modify risk factors (tobacco use, harmful use of alcohol, physical inactivity, unhealthy eating behaviors, overweight/obesity, among others) (World Health Organization, 2018). However, some investigations are focused on analyzing the clustering of

multiple behavioral risk factors for NCDs, providing supportive interventions that target multiple risk behaviors, helping to plan future preventive strategies (Meade *et al.*, 2016; Noble *et al.*, 2015).

In addition, sociodemographic conditions, and their relationship with NCDs and how lifestyle can influence the quality of life of the elderly. The problems related to overweight are common and are directly associated with socioeconomic conditions and high consumption of carbohydrate-rich foods, in addition to the automation of daily activities and sedentary lifestyle (Silva *et al.*, 2018). Therefore, it is necessary to investigate the factors that trigger possible NCDs in the elderly to understand the relationship of modifiable risk factors with sociodemographic factors for epidemiology (Bertram *et al.*, 2018).

The development of NCDs is quite common in cases of excess of modifiable risk factors and even more frequent due to sociodemographic factors. Through combinations of two or more risk factors, the elderly is more exposed to NCDs, therefore, it was defined that those individuals who have more than one risk factor are in a worse health situation and whose sociodemographic factors can interfere with the conditions of life (Cruz *et al.* 2017). However, the combination of five modifiable factors and their impact on sociodemographic conditions and on the prognosis of elderly individuals is still unknown. Therefore, our objective is to analyze the simultaneity of the five risk factors for NCDs in low-income elderly people living in a rural city in Brazil and to show their impact on the association with sociodemographic variables. Our hypothesis is that there are different risk factors and that there is a correlation between them, as observed in Cruz *et al.*, 2017. It is expected that there are conglomerations in relation to modifiable risk factors associated with sociodemographic factors, as significant clusters NCDs can lead to this condition and the prognosis of these diseases in the elderly population.

2. Methodology

This cross-sectional and population-based study is part of a macro project entitled Monitoring the health conditions of the elderly in a small municipality (MONIDI) and was approved by the Ethics Committee of Human Science (CAAE: 22969013.0.0000.0055) and it is in accordance with The Declaration of Helsinki. Informed consent was obtained from each participant. The study area was developed in 2014 in the city of Ibicuí. and it is in accordance with The Declaration of Helsinki. Informed consent was obtained from each participant. The study area was developed in 2014 in the city of Ibicuí. This municipality is located in a rural area of Brazil, in the southwest of the state of Bahia, it has a territorial area of 1,139,378 km², and an estimated population of 16,640 inhabitants, in the sampling period (IBGE, 2019).

To compose the sample, 335 individuals were selected, and the sample size was calculated considering a significance level of 5%, confidence interval of 95% and tolerable error of 3%. In addition, there was a 7.4% rate (n = 25) of sample loss and the response rate was 92.6%, with a final sample comprising 310 individuals, who were registered in the Family Health Strategy (FHS).

Inclusion criteria were: individuals aged 60 years or more (as defined by Brazilian legislation), residing in rural and urban areas registered with the FHS in the city of Ibicuí-BA. Exclusion criteria were the presence of diagnosis of dementia or any other type of cognitive impairment (with diagnosis recorded in the medical record of the Family Health Unit) compromised the veracity of the information. Was used for cognitive status assessment the Mini Mental State Examination (MMSE) as criteria only in the chosen participants (Brandão *et al.*, 2019).

Data were collected through a questionnaire called the Health Assessment Instrument of the Elderly (IASI), previously validated instrument (Pedreira *et al.*, 2016), applied in the form of an individual interview, followed by an anthropometric assessment.

The following sociodemographic variables were included in the study: sex (male/female), age (in complete years), skin color (white/nonwhite), schooling (literate/not literate), marital status (without partner/partner); modifiable risk factors: leisure-

time physical inactivity, regular consumption of alcohol, smoking, sedentary behavior, overweight/obesity, which were collected and operated as described in Table 1.

Table 1. Description and classification of sociodemographic variables with modifiable risk factors.

Variables	Definition	Question
Physical inactivity in leisure (PIL)	Does not practice at least 150 min/ without physical activity in your free time	How would you rate your leisure activity?
Regular consumption of alcohol (AL)	Whether or not you are currently drinking alcohol	Do you drink alcohol? How often?
Smoke now (SMO)	Currently or not smoke	Do you smoke?
Sedentary behavior (SB)	Sitting time >2 hours/day	How much time do you spend sitting on a normal weekday, and on a normal weekend day?
Overweight/obesity (OVR)	Measure of body mass and height	Evaluated by means of the calculation of Body Mass Index

Source: Adapted from: Pedreira *et al.*, (2016); Pitanga *et al.*, (2005); Matsudo *et al.*, (2001); Lipschitz *et al.*, (1994).

Anthropometric measurements were taken (body mass and height) and evaluated by a previously trained professional. The Body Mass Index (BMI) was evaluated with a portable digital scale (OMRON®) for weight and with a stadiometer (Sanny®) for height and calculated by dividing weight (Kg) by height squared (m²). Overweight values were those equal to or greater than 25.0 kg / m (Gibson, 1990).

2.1 Statistical analysis

Statistical analysis of the data was performed using descriptive statistics procedures, association measures for categorical variables (Chi-square Test) and cluster analysis using Statistical Package for Social Sciences - SPSS for Windows® version 22.0. A 95% confidence interval and significance level of 5% were adopted for data analysis and interpretation. The clustering of behavioral risk factors was analyzed, stratifying by sex. When the prevalence of the combination of observed behaviors (O) was greater than the expected prevalence (E), it was considered a new grouping. To identify the expected prevalence values of each combination, the individual probability of occurrence of each behavior was multiplied by the occurrence observed in the study; when the ratio between observed/expected (O/E) was > 1, then a grouping was considered (Tassitano *et al.*, 2014; Schuit *et al.*, 2002; Galán *et al.*, 2005). Multivariate analysis (logistic regression) was performed to evaluate the association between the accumulation of risk factors and the independent variables.

3. Results and Discussion

Chronic non-communicable diseases are common, but little is known about the characteristics of risk factors combined with demographic variables of elderly people with low economic status. To define the simultaneity characteristics of the five risk factors for NCDs in a rural city in Brazil, we analyzed and compared the sociodemographic variables of 310 low-income elderly.

When performing this analysis, we observed that the mean age was 71.62 (± 8.16) years and most were women (n = 175), who recognized themselves as non-white (71.8%), literate (56.3%) and lived without a partner (51.1%) (Table 2). When analyzing each risk factor, according to sociodemographic variables, the highest percentage for men and women was overweight / obesity (47.9% and 52.1%, respectively). In all risk factors, the prevalence was predominant in ages between 60-79 years. Non-white individuals had higher percentages in all behaviors compared.

Table 2. Characteristics of risk factors according to sociodemographic variables of elderly. Ibicuí, Bahia, Brazil, 2014.

Variables	Full Sample	PIL	AL	SMO	SB	OVR
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	310 (100)	96 (31.0)	13 (4.2)	36 (11.6)	133 (43.0)	119 (39.7)
Sex						
Male	135(43.5)	88 (41.1)	9 (69.2)	21 (58.3)	62 (46.6)	57 (47.9)
Female	175 (56.5)	126 (58.9)	4 (30.8)	15 (41.7)	71 (53.4)	62 (52.1)
Age						
60-79	260 (83.9)	179 (83.6)	11 (84.6)	31 (86.1)	110 (82.7)	97 (81.5)
≥ 80	50 (16.1)	35(16.4)	2 (15.4)	5 (13.9)	23 (17.3)	22 (18.5)
Skin color						
White	87 (28.3)	54 (25.5.)	5 (38.5)	12 (33.3)	37 (28.0)	29 (24.6)
Nonwhite	220 (71.7)	158 (74.5)	8 (61.5)	24 (66.7)	95 (72.0)	89 (75.4)
Schooling						
Literate	174 (56.1)	76 (56.3)	6 (46.2)	17 (47.2)	78 (58.6)	54 (45.4)
Not literate	135 (43.9)	59 (46.7)	7 (53.8)	19 (52.8)	55 (41.4)	65 (54.6)
Marital status						
With company	158 (51.0)	110 (51.4)	6 (46.2)	17 (47.2)	57 (42.9)	52 (43.7)
Without company	152 (49.0)	104 (48.6)	7 (53.8)	19 (52.8)	76 (51.7)	67 (56.3)

Note: PIL = Physical inactivity in leisure; AL = Alcohol; SMO = Smoked; SB = Sedentary behavior; OVR = overweight/obesity. Source: Authors (2021).

According to a study by Xiao Li *et al.* 2019 obesity was also a factor with a high percentile, showing that it is directly associated with non-communicable chronic diseases in the majority of women with a multimorbid lifestyle. Which can be associated with several genetic factors such as menopause, climacteric or as shown below with sedentary lifestyle.

When analyzing all behaviors, we found that there were thirty-two possible combinations in observed, expected frequencies and the O/E ratio, related to behavioral risk factors (Table 3). The most frequent grouping observed was smoking + sedentary behavior (82.2% in men and 89.1% in women). In addition, the grouping of the five behaviors (physical inactivity in leisure, alcoholism, smoking, sedentary behavior, overweight/obesity) had high scores in both sexes (O/E = 242.5 in men and O/E = 161.7 in women). In the simultaneous prevalence of four risk factors, the alcoholism + smoking + sedentary behavior + overweight/obesity group had high scores in both sexes (O/E = 467.0 in men and O/E = 143.7 in women). The three concomitant risk factors: alcoholism + smoking + overweight/obesity and physical inactivity in leisure + alcoholism + smoking were the most prevalent groups, in men (O/E = 751.2) and in women (O/E = 120.0), respectively.

Furthermore, for two concomitant behaviors, the physical inactivity in leisure + smoked, had high scores in women (O/E = 192.6) and among men, they showed that alcoholism + smoking (O/E = 500.0), showed high scores. When considering the presence of a risk factor, excessive alcohol consumption (O/E = 71.2) was more prevalent in men and tuxedo among women (O/E = 9.0).

Table 3. Prevalence of five combinations of health risk behaviors in the elderly population. Ibicuí, Bahia, Brazil, 2014.

Risk of factors	PIL	AL	SMO	SB	OVR	Men			Women		
						O (%)	E	O/E	O (%)	E	O/E
5	+	+	+	+	+	48.5	0.2	242.5	48.5	0.3	161.7
4	-	+	+	+	+	46.7	0.1	467.0	43.1	0.3	143.7
4	+	-	+	+	+	53.7	2.2	24.6	50.9	0.7	74.4
4	+	+	-	+	+	53.7	0.8	63.4	48.5	2.3	20.9
4	+	+	+	-	+	59.0	0.1	443.8	51.5	0.5	95.6
4	+	+	+	+	-	44.8	0.2	211.3	40.0	0.3	141.0
3	-	-	+	+	+	55.6	1.2	47.7	57.5	0.6	89.2
3	-	+	-	+	+	48.1	0.5	106.3	3.3	1.3	2.6
3	-	+	+	-	+	53.3	0.1	751.2	0.2	0.3	0.7
3	-	+	+	+	-	6.7	0.7	59.2	1.0	6.9	0.1
3	+	-	-	+	+	50.0	11.8	4.2	53.3	5.6	9.5
3	+	-	+	-	+	46.3	1.9	25.0	49.1	1.3	37.8
3	+	-	+	+	-	57.5	3.0	19.5	57.0	0.7	83.3
3	+	+	-	-	+	46.3	0.7	64.4	46.7	4.4	10.6
3	+	+	-	+	-	42.5	1.1	37.1	53.3	2.3	23.0
3	+	+	+	-	-	55.2	0.2	276.0	60.0	0.5	120.0
2	-	-	-	+	+	54.1	6.3	8.6	65.5	5.3	12.4
2	-	-	+	-	+	44.4	1.0	44.9	57.5	1.2	47.0
2	-	-	+	+	-	82.2	1.6	52.2	89.1	0.6	148.5
2	+	-	-	-	+	50.0	10.0	5.0	46.7	10.6	4.4
2	+	-	-	+	-	59.7	16.0	3.7	48.5	5.6	8.7
2	+	+	-	-	-	57.5	1.0	59.1	43.0	1.3	33.1
2	-	+	-	-	+	51.9	0.4	135.2	46.7	4.4	10.6
2	-	+	+	-	-	50.0	0.1	500.0	47.1	4.1	11.4
2	-	+	-	+	-	46.3	0.6	75.6	70.7	2.2	32.4
2	+	-	+	-	-	42.5	2.5	17.0	97.7	0.5	192.6
1	-	-	-	-	+	45.9	5.4	8.6	50.0	10.0	5.0
1	-	-	-	+	-	40.7	8,5	4.8	34.5	5.3	6.6
1	-	-	+	-	-	17.8	1.3	13.3	10.9	1.2	9.0
1	-	+	-	-	-	37.0	0.5	71.2	51.5	10.6	4.9
1	+	-	-	-	-	40.3	13.6	3.0	29.3	4.1	7.1
0	-	-	-	-	-	59.3	7.2	8.2	65.5	10.0	6.6

Note: PIL = Physical inactivity in leisure; AL = Alcohol; SMO = Smoked; SB = Sedentary behavior; OVR = overweight/obesity. O = observed; E = expected; O/E = observed/expected; + = Present Factor; - = Absent Factor. Source: Authors (2021).

Sedentary behavior is an important marker used in the present study because 43.8% of elderly Brazilians have sedentary behavior (Vigitel Brasil, 2019) and, in this population, this behavior is associated with poor cardiometabolic risk markers (Figueiró *et al.*, 2019). The combinations of factors show that smoking and sedentary behavior are more prevalent in women,

contrary to the study by Cruz *et al.*, 2017. That in men the prevalence of smoking and physical inactivity was higher, in this same study it is shown that smoking and overweight influence each other, which is slightly linked to the obesity data.

When we analyze the simultaneity of risk factors for NCDs in elderly people with low economic status, it can be seen that the prevalence is in men. if something is harmful to your health, other studies suggest that the onset of some diseases has caused greater physical inactivity, which is directly linked to obesity levels (Brandão *et al.*, 2019; Cruz *et al.*, 2017). Table 4 shows no prevalence (gross and adjusted) of three or more risk factors with socio-demographic characteristics.

Table 4. Association between the presences of NCDs behavioral risk factors with socio-demographic characteristics of elderly. Ibicuí, Bahia, Brazil, 2014.

	OR_{gross} (95% CI)*	OR_{adjusted} (95% CI)**
Sex		
Male	1	1
Female	1.02 (0.90-1.16)	1.03 (0.93-1.13)
Age Range		
60-79	1	1
≥ 80	1.47 (0.67-3.16)	1.06 (0.93-1.20)
Skin color		
Non- White	1	1
White	0.96 (0.83-1.10)	0.96 (0.87-1.07)
Schooling		
Literate	1	1
Not literate	1.40 (0.82-2.41)	1.04 (0.95-1.15)
Marital Status		
With company	1	1
Without company	0.88 (0.52-1.50)	0.99 (0.90-1.09)

Note. OR = Odds ratio; CI = Confidence interval; * = Gross for all independent variables; ** = Adjusted by all independent variables. Source: Authors (2021).

Regarding clustering of simultaneous risk factors for chronic non-communicable diseases in the elderly, simultaneous excessive consumption of alcohol with smoking, and physical inactivity with smoking were the groups with the highest scores among men and women. When analyzing the association between these groups with sociodemographic characteristics, only the association between physical inactivity with smoking and sex was observed. Among the risk behaviors, the results showed that there most prevalent combination for men was alcohol, overweight/obesity, and smoking (O/E = 751.2), and for women it was physical inactivity and smoking (O/E = 192.6) (Table 5).

Table 5. Relation between two combinations of the most prevalent health risk behaviors in sociodemographic variables in the elderly. Ibicuí, Bahia, Brazil, 2014.

	AL+SMO+OB+SB		PIL+SMO	
	n (%)	OR (95% CI)	n (%)	OR (95% CI)
Sex				
Male	1 (0.7)	1	7 (5.2)	1
Female	1 (0.6)	0.99 (0.97-1.01)	3 (1.7)	0.96 (0.92-0.98)
Age range				
60-79	1 (0.4)	1	9 (3.5)	1
≥ 80	1 (2.0)	1.01 (0.98-1.03)	1 (2.0)	0.97 (0.92-1.03)
Skin color				
Nonwhite	1 (1.1)	1	6 (2.7)	1
White	1 (0.5)	1.01 (0.98-1.02)	4 (4.6)	1.02 (0.97-1.06)
Schooling				
Literate	1 (0.5)	1	6 (3.4)	1
Not literate	2 (1.5)	1.01 (0.99-1.03)	4 (2.9)	0.99 (0.95-1.03)
Marital Status				
With company	2 (1.3)	1	3 (2.0)	1
Without company	1 (0.4)	1.01 (0.99-1.03)	7 (4.4)	1.03 (0.99-1.07)

Note. PIL = Physical inactivity in leisure; AL = Alcohol; SMO = Smoked; SB = Sedentary behavior; OVR = overweight/obesity; OR = Odds ratio; CI = Confidence interval. Source: Authors (2021).

These are directly linked to lifestyles interfering with the work of muscles (Brandão *et al.*, 2019). Smoking is a variable observed in both sexes of the study that has been presented in other clustering studies of elderly people. A Chinese study showed an association between smoking and alcohol, physical inactivity, and low consumption of vegetables and fruits for both sexes (Chou, 2008). A study conducted by Meader *et al.*, 2016 showed an association between smoking and alcohol misuse or smoking and an unhealthy diet. A Poortinga's Study, 2007 showed clustering between heavy smoking, drinking, and lack of fruit/vegetables, these factors contribute to the development of chronic diseases such as cancer and diabetes.

In addition, a study conducted by Schuit *et al.*, 2002 showed clustering of smoking with low vegetable and fruit consumption, excessive alcohol intake, and low physical activity. Smoking was also included in a regional study with elderly Brazilians, clustering with physical inactivity for men, and physical inactivity and alcohol for women (Cruz *et al.*, 2017). However, Cruz's study 2017 used just four risk factors (physical inactivity, smoking, alcohol consumption and overweight/obesity). Other data found in this study relates to the association between two behaviors of health risk with the variable sex. In this way, men are more physically inactive and smoke more than women (Chou, 2008).

Furthermore, it was found that elderly people had two or more NCDs risk factors. These results encourage public health policy to enable equity and facilitate healthier choices for all ages, especially because projections of demographic aging in Brazil are faster than world projections (United Nations, 2015). Studies that analyze the simultaneity of risk factors in the elderly are still scarce in the literature since most studies target adolescents and young adults as one of the study's strengths.

The present study was carried out in a city in a rural city in the largest state in Northeastern Brazil, but the sample was small, as not all elderly people living in the region were registered at the Family Health Unit in the city. As a limitation of this study, it can be highlighted that cross-sectional studies do not ensure direct causal relationships between the studied variables.

The use of self-reported information, despite being a strategy widely used in epidemiological studies, may be susceptible to information bias. However, this study has some strengths such as 1) developed a population-based survey; 2) showed the profile of elderly people that have a low socioeconomic status; 3) adopted screening strategies and data collection instruments recommended in the literature for studies with the elderly population; 4) analyzed clustering of five risk factors for chronic non-communicable diseases, including sedentary behavior. The use of strategies to investigate aggregated risk factors may contribute to the definition of the burden of diseases and to the establishment of prevention programs in the field of public health.

4. Conclusion

The present study was based on data related to the macroproject Monitoring the Health Conditions of Elderly People (MONIDI) in a small municipality in the state of Bahia, Brazil (Nascimento, *et al.*; 2015). According to this can be concluded that the elderly is exposed to health risk factors for concurrent NCDs. The most prevalent simultaneous behavior in both sexes was alcoholism, smoking, and overweight/obesity. However, the accumulation of these risk factors was not associated with sociodemographic variables. The simultaneous presence of a sedentary lifestyle and smoking was lower among women when compared to men. Another important factor was the association of tobacco and obesity, with overweight being more associated with a sedentary lifestyle and smoking with other factors. We suggest that future articles and research be carried out with more variables, as well as analyzing why the elderly population presents these levels according to gender, as some studies show that women are more prevalent in these same factors (smoking and excessive weight / obese) and others show that these are men with high percentiles.

Acknowledgments

The authors would like to thank the Monitoring Study team of the health conditions of the elderly (MONIDI) and the National Council for Scientific and Technological Development (CNPQ).

References

- Bennett, E. J., Stevens, G. A., Mathers, C. D., Bonita, R., Rehm, J., Kruk, L. M., Dain, K., Kengne, A. P., Chalkidou, K., Beagle, J., Kishore, S. P., Chen, W., Saxena, S., Bettcher, D. W., Grove, J. T., Beaglehole, R., & Ezzati, M. (2018). NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *Lancet* 22;392(10152):1072-88. [https://doi.org/10.1016/S0140-6736\(18\)31992-5](https://doi.org/10.1016/S0140-6736(18)31992-5)
- Bertram, M. Y., Sweeny, K., Lauer, J. A., Chisholm, D., Sheehan, P., Rasmussen, B., Upreti, S. R., Dixit, L. P., George, K., & Deane, S. (2018). Investing in non-communicable diseases: an estimation of the return on investment for prevention and treatment services. *The Lancet*, 391(10134), 2071–2078. [https://doi.org/10.1016/S0140-6736\(18\)30665-2](https://doi.org/10.1016/S0140-6736(18)30665-2)
- Bloom, D. E., Chatterji, S., Kowal, P., Lloyd-Sherlock, P., McKee, M., Rechel, B., Rosenberg, L. & Smith, P. J. (2015). Macroeconomic implications of population ageing and selected policy responses. *Lancet*. 14, 385(9968): 649–657. [https://doi.org/10.1016/S0140-6736\(14\)61464-1](https://doi.org/10.1016/S0140-6736(14)61464-1)
- Brandão, T. L., Lago, K. N., Rocha, S. V. (2019) Sedentary behavior and functional disability in the elderly with low economic status: Monidi Study. *Rev. bras. cineantropom. desempenho hum* 21. 21: e55944. <https://doi.org/10.5007/1980-0037.2019v21e55944>
- Brazil. Decreto n. 8,166 de 23 de dezembro de 2013. Planalto do Governo. http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2013/Decreto/D8166.htm.
- Brazil. Vigitel Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2018. Brasília: Ministério da Saúde. <https://portal.arquivos2.saude.gov.br/images/pdf/2019/julho/25/vigitel-brasil-2018.pdf>
- Chou, K. L. (2008). The prevalence and clustering of four major lifestyle risk factors in Hong Kong Chinese older adults. *Journal of Aging and Health*, 20(7), 788–803. <https://doi.org/10.1177/0898264308321082>
- Costa, F. F., Benedet, J., Leal D. B. & Assis M. A. (2013). Clustering of risk factors for non-communicable diseases in adults from Florianópolis SC. *Rev Bras Epidemiol*, 16(2), 398–408. <https://doi.org/10.1590/S1415-790X2013000200015>
- da Cruz, M. F., Ramires, V. V., Wendt, A., Mielke, G. I., Martinez-Mesa, J., & Wehrmeister, F. C. (2017). Simultaneity of risk factors for chronic non-communicable diseases in the elderly in Pelotas, Rio Grande do Sul State, Brazil. *Cadernos de Saude Publica*, 33(2). <https://doi.org/10.1590/0102-311X00021916>
- Figueiró, T. H., Arins, G. C. B., dos Santos, C. E. S., Cembranel, F., de Medeiros, P. A., d'Orsi, E., & Rech, C. R. (2019). Association of objectively measured sedentary behavior and physical activity with cardiometabolic risk markers in older adults. *PLoS ONE*, 14(1), 1–15. <https://doi.org/10.1371/journal.pone.0210861>
- Galán, I., Rodríguez-Artalejo, F., Tobías, A., Díez-Gañán, L., Gandarillas, A., & Zorrilla, B. (2005). Clustering of behavior-related risk factors and its association with subjective health. *Gaceta Sanitaria / S.E.S.P.A.S.*, 19(5), 370–378. <https://doi.org/10.1157/13080135>
- Gibson, R. S. (1990) Anthropometric reference data. In: Gibson RS. Principles of nutritional assessment. New York: Oxford University Press; Pt.12. p.20946.
- IBGE. Ibicuí. (2018) <https://cidades.ibge.gov.br/brasil/ba/ibicui/panorama>.
- IBGE. Tabela 2010-2060 - Projeção da População (2018) <https://agenciadenoticias.ibge.gov.br/agencia-detalle-de-midia.html?view=mediaibge&catid=2103&id=2188>

- Lipschitz, D. A. (1994) Screening for nutritional status in the elderly. *Prim Care*, 21(1):55-67.
- Matsudo, S., Araújo, T., Matsudo, V., Andrade, D., Andrade, E., Oliveira, L. C., & Braggion, G. (2012). Questionário internacional de atividade física (ipaq): estudo de validade e reprodutibilidade no Brasil. *Revista Brasileira De Atividade Física & Saúde*, 6(2), 5–18. <https://doi.org/10.12820/rbafs.v.6n2p5-18>.
- Meader, N., King, K., Moe-Byrne, T., Wright, K., Graham, H., Petticrew, M., Power, C., White, M., & Sowden, A. J. (2016). A systematic review on the clustering and co-occurrence of multiple risk behaviours. *BMC Public Health*, 16(1), 1–9. <https://doi.org/10.1186/s12889-016-3373-6>
- Muniz, L. C., Schneider, B. C., Silva, I. C., Matijasevich, A., & Santos, I. S. (2012). Accumulated behavioral risk factors for cardiovascular diseases in Southern Brazil. *Rev Saude Publica Jun*;46(3):534-42. 10.1590/s0034-89102012005000021
- Nascimento, R. A. S., Batista, R. T. S., Rocha, S. V., Vasconcelos, L. R. C. (2015). Prevalence and factors associated with the decline in the elderly with cognitive low economic condition: MONIDI study. *J. bras. psiquiatr.* 64 (3). <https://doi.org/10.1590/0047-2085000000077>
- Noble, N., Paul, C., Turon, H., & Oldmeadow, C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. (2015). *Prev Med*, 81:16-41. <https://doi.org/10.1016/j.ypmed.2015.07.003>
- Nunes, H. E. G., Gonçalves, E. C. A., Vieira, J. A. J., & Silva, D. A. S. (2016). Clustering of risk factors for non-communicable diseases among adolescents from Southern Brazil. *PLoS One*, 11(7): e0159037. <https://doi.org/10.1371/journal.pone.0159037>
- Oliveira, A. S. D., Moreira, N. F., Moraes, A. B., V., Pereira, R. A., & Veiga, G. V. (2017). Co-occurrence of behavioral risk factors for chronic non-communicable diseases in adolescents: prevalence and associated factors. *Rev Nutr*, 201;30(6):747-58. <https://doi.org/10.1590/1678-98652017000600007>
- Pedreira, R. B. S., Rocha, S. V., Santos, C. A., Vasconcelos L. R. C., & Reis, M. C. (2016). Content validity of the Geriatric Health Assessment Instrument. *Einstein (São Paulo)*, 14(2):158-77. 10.1590/S1679-45082016AO3455
- Pitanga, F. J., & Lessa, I. (2005). Prevalência e fatores associados ao sedentarismo no lazer em adultos. *Cad Saude Publica*, 21(3):870-7. <https://doi.org/10.1590/S0102-311X2005000300021>
- Poortinga, W. (2007). The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Preventive Medicine*, 44(2), 124–128. <https://doi.org/10.1016/j.ypmed.2006.10.006>
- Ricardo, C. Z., Azeredo, C. M., Rezende, L. F. M., & Levy, R. B. (2019). Co-occurrence and clustering of the four major non-communicable disease risk factors in Brazilian adolescents: analysis of a national school-based survey. *PLoS One*, 14(7): e0219370. <https://doi.org/10.1371/journal.pone.0219370>
- Silva, V. S., Souza, I., Silva, D. A. S., Barbosa, A. R., Fonseca, M. J. M. (2018). Tendências e associação do IMC entre variáveis sociodemográficas e de condições de vida em idosos brasileiros: 2002 / 03-2008 / 09. *Ciênc. saúde colet*, 23 (3). <https://doi.org/10.1590/1413-81232018233.12532016>
- Schuit, A. J., van Loon, A. J., Tijhuis, M., & Ocké, M. (2002). Clustering of Lifestyle Risk Factors in a General Adult Population. *Prev Med*, 35(3):219-24. 10.1006/pmed.2002.1064
- Silva, D. A. S., Peres, K. G., Boing, A. F., González-Chica, D. A., & Peres, M. A. (2013) Clustering of risk behaviors for chronic noncommunicable diseases: a population-based study in southern Brazil. *Prev Med*, 56(1):20-4. 10.1016/j.ypmed.2012.10.022
- Tassitano, R. M., Dumith, S. C., Chica, D. A. G., & Tenório, M. C. M. (2014). Aggregation of the four main risk factors to non-communicable diseases among adolescents. *Rev Bras Epidemiol*, 17(2):465-78. <https://doi.org/10.1590/1809-4503201400020014ENG>
- United Nations. (2015). World Population Prospects: the 2015 revision. UN
- World Health Organization. Noncommunicable diseases country profiles. (2018). WHO
- Williams, J., Allen, L., Wickramasinghe, K., Mikkelsen, B., Roberts, N., & Townsend, N. (2018). A systematic review of associations between non-communicable diseases and socioeconomic status within low- and lower-middle-income countries. *Journal of global health*, 8(2), 020409. <https://doi.org/10.7189/jogh.08.020409>
- Xiao, L., Le Cai, Cui W., Wang, X., Hui-fang, L., Jian-hui H., & Golden, A. R. (2020). Association of socioeconomic and lifestyle factors with chronic non-communicable diseases and multimorbidity among the elderly in rural southwest China. *Journal of Public Health*, 26;42(2):239-246. 10.1093/pubmed/fdz020