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JOURNAL OF Novel Physiotherapy and Physical Rehabilitation
OPEN ACCESS JOURNAL

ISSN: 2455-5487 DOI: https://dx.doi.org/10.17352/jnppr

Research Article

Influence of geographical space on the strength of the breathing muscles of elderly residents in the rural and urban areas of the high hinterland of Paraiba

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Received: 22 August, 2023
Accepted: 28 August, 2023
Published: 29 August, 2023

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Keywords: Environmental conditions; Aging; Respiratory system; Maximum respiratory pressures; Collective health

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Abstract

Introduction: We observe, in the aging process, important functional changes in our organism that can be influenced by the environment in which we are inserted.

Objective: To comparatively evaluate the respiratory muscle strength of elderly people in rural and urban areas.

Methodology: This is a cross-sectional and analytical research, whose data were analyzed quantitatively, which was carried out with elderly people living in the urban area, registered at the Social Assistance Reference Center (CRAS), and in the rural area, at the Urban Social Center (CSU) in Sousa city, in Paraíba state. The sample was random and for convenience. An anthropometric and respiratory muscle strength assessment was carried out. Individuals aged 60 years or older, of both sexes, who had good mental conditions to answer the questions and could walk were included, and those who had cognitive deficits, visual, cardiac, respiratory, neurological problems, and neoplasms were excluded.

Results: 84 elderly people participated in the research, of both sexes, divided into two groups: urban area (n = 43) and rural area (n = 41). With regard to respiratory muscle strength, when comparing the maximal Inspiratory Pressure (IP_{max}) with the maximal expiratory pressure (PE_{max}) of the elderly in relation to the place of residence, there were no statistically significant results in the evaluated variables ($p > 0.05$).

Conclusion: There was no statistically significant difference in the respiratory muscle strength of the elderly evaluated at the expense of the habitat.

Introduction

Aging, which is inherent to all living beings, progresses dynamically and is characterized by changes in the psychic, social, and biological fields. Factors such as socioeconomic conditions, isolation, loss of autonomy, and dependence are social concerns arising from the aging process [1]. In Brazil, around 14 million people are elderly -15.7% in rural areas and 84.3% in urban areas [2]. Regarding future perspectives, it is estimated that, in the next 40 years, Brazil will have more people aged over 60 than young people under 20 [3,4].

As for the conditions of the elderly population in rural and urban areas, there are several factors that influence the quality of their life, such as demographic and socioeconomic aspects, level of education, and access to health and basic sanitation. Specifically in Brazil, those residing in rural areas perceive the lowest average monthly income, reduced level of education,

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DOI: https://dx.doi.org/10.17352/2455-5487.000101

low coverage of health plans, and higher rates of smoking and physical activity at work. The access distance between zones is a factor that contributes to changing the quality of life [5].

Health is closely related to the stage of life characterized as old age since the body is susceptible to diseases and hormonal, neuroendocrine, neurological, immunological, and respiratory changes, which can negatively affect the health of these individuals [6]. The strength and muscle mass of the skeletal and respiratory systems decrease gradually and progressively. The reduction in lung function and the mobility of the thoracic cage lead to a consequent decrease in lung volumes and capacities and are directly related to the decline in Respiratory Muscle Strength (RMS) [7].

The changes that occur in the organism during the senescence process decrease the strength of the skeletal muscles. This decrease is similar in the respiratory muscles. These age-related changes increase the work of the respiratory muscles and, in addition to the comorbidities that arise, muscle mass decreases. This is a factor that can reduce the endurance and strength of the respiratory muscles. In addition to age, gender and weight influence measurements of Maximum Inspiratory Pressure (MIP) [8].

The measurement of Maximum Respiratory Pressure (MRP) is what makes it possible to investigate the strength conditions of the respiratory muscles, through the process known as manovacuometry, in which it is possible to identify probable weaknesses, fatigue, and failure of the respiratory muscles, which are responsible for the functioning Harmonic of the respiratory system [9].

The loss of respiratory muscle strength in the elderly can be a predictive factor of a decline in functional integrity. Interventions aimed at minimizing this loss are important because they reduce the complications caused by respiratory diseases and, consequently, the impairment in the quality of life and functional capacity of the elderly [9].

For these reasons, it is important to study the influence of the habitat on the respiratory muscle strength of the elderly, since the lifestyle in the urban area is different from that of the rural area, which may influence this strength. In this perspective, the objective of this research was to comparatively evaluate respiratory muscle strength among elderly people in rural and urban areas.

Methodology

Characterization and study location

This is an analytical cross-sectional research with a quantitative approach, carried out in the high hinterland of Paraíba with the elderly registered in the Reference and Social Assistance Center (CRAS) in the city of Sousa/PB and residents in the rural area of the municipality of São Domingos /PB.

Patient selection and data collection

Participants were selected by convenience and at random, and the study sample consisted of 84 elderly people: 41 from the rural area (16 men and 25 women) and 43 from the urban area (7 men and 36 women).

Data were collected between February and March 2020. Individuals aged 60 years or older, of both sexes, with good mental conditions to answer the questions on the collection instruments, who were able to walk around and who voluntarily agreed to participate in the study were included, and those with cognitive impairment were excluded (observation carried out by the evaluator during the invitation to participate in the research), visual, cardiac, respiratory, neurological and neoplasia conditions.

The research instrument consisted of a semi-structured questionnaire to collect personal and sociodemographic data, information on personal/family history (respiratory, cardiac, renal disease, arterial hypertension, diabetes mellitus), life habits, general health status, anthropometry, and respiratory muscle strength, measured using a manuvacuometer device.

Anthropometric parameters

Weight was measured using a G-Tech digital scale, with a capacity of 180 kg and variation in grams, positioned on a flat and firm surface. The participant was instructed to remove all adornments and wear light clothes for the evaluation.

When the zero marking was present on the display, the volunteer was instructed to step barefoot with one foot on each side of the scale platform and stand still with arms along the body. The weight was recorded on the form, and the individual was instructed to step down [10].

Height was measured with a stadiometer fixed to a wall without baseboard, with a length of two meters. The participant was positioned with feet together, knees extended and eyes turned towards the horizon. After that, the body mass index (BMI) was calculated considering the formula defined as the weight (in kg) divided by the square of height (in meters) [11,12].

To evaluate the BMI results, the values established by the Pan American Health Organization (PAHO) were adopted, which present the following classification: low weight (BMI ≤ 23 kg/m^2), adequate weight (BMI > 23 and < 28 kg/m^2), pre-obesity (BMI ≥ 28 and < 30 kg/m^2) and obesity (BMI ≥ 30 kg/m^2) [13].

To measure the abdominal circumference, the individuals stood in the orthostatic position, with their arms apart, feet together, and the upper part naked up to the height of the diaphragm. A flexible and inextensible measuring tape was used, positioned based on the midpoint between the iliac crest and the last rib.

Excess abdominal fat was considered for abdominal circumference values greater than 94 cm in men and greater than 80 cm in women. These results were associated with a significant risk factor for cardiovascular disease [14].

The Waist/Hip Ratio (WHR) was performed by measuring the waist circumference described above and the hip

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circumference, measured with the participant standing, with the abdomen relaxed and arms relaxed at the side of the body. The measuring tape was placed horizontally around the hip in the most prominent part of the buttocks. Values found above 0.85 in women and 0.90 in men presuppose a risk of developing metabolic alterations [15].

Respiratory parameters

Respiratory Muscle Strength (RMS) was collected using a Wika® analog manovacuometer device (São Paulo, Brazil), with which the maximum respiratory pressures (MIP and MEP) were measured, adjusted in cm H_2O and with a variation of ± 300 cm H_2O. The device has a small orifice, approximately 1mm in diameter and 20 to 30mm in length, which allows air to exit [16].

The participants were evaluated in the sitting position, with the spine erect and the trunk at 90° in relation to the hips. Their noses were occluded with a nose clip throughout the evaluation, holding the mouthpiece firmly against their lips to prevent perioral air leakage. So that the MIP and MEP results do not fluctuate during the test, it was recommended that the serial determinations were always performed in the same posture [17].

To measure MIP, an expiration at Residual Volume (RV) level was requested, followed by a quick and strong inspiration to Total Lung Capacity (TLC), sustained for at least three seconds, and to measure MEP, a maximal inspiration to the TLC level followed by maximal expiration to the RV level, which was also maintained for at least three seconds. Three measurements were taken and the highest value was adopted [18]. During the maneuvers, the participants received standardized verbal stimuli. Intervals of 15 seconds between measurements were adopted; 1 minute, between changing the tracheas; and 30 seconds between maneuvers [19].

Statistical analysis

The results are shown in graphs and tables. Categorical variables were described in absolute frequencies (n) and relative frequencies (%).

To analyze them, the statistical software EPI INFO® version 7.2.3.1 was used, using the chi-square test. Quantitative variables were expressed as mean and standard deviation. Analyzes were performed using the statistical software BioEstat® version 5.0 (Instituto Mamirauá, Belém, Brazil).

The Shapiro-Wilk normality test, the Mann-Whitney Test or Analysis of Variance (ANOVA), and Tukey's post-test were used. Significant differences were considered when $p < 0.05$.

Ethical aspects

The research is part of the study entitled 'Relationship between Skeletal Muscular Strength and Vitamin D in Elderly People in Urban and Rural Areas', which was approved by the Research Ethics Committee of the Faculty of Santa Maria, under protocol nº 3,376,161, respecting the guidelines and rules of Resolution 466/12.

Results

The distribution of elderly participants in the research according to their sociodemographic characteristics is shown in Table 1. The study indicated that individuals in rural areas have an average age of 68.29, and those in the urban area, 70.53. Most of those surveyed in rural and urban areas are, respectively, of mixed ethnicity (65.85% and 55.81%), with incomplete primary education (51.22% and 58.14%), per capita income of up to 1 minimum wage (97.56% and 95.34%) and retirees (100% and 93.01%). These characteristics are mentioned in Table 1.

The number of males residing in the rural area (39.02%) was greater than those in the urban area (16.28%) ($p < 0.05$). With regard to marital status, 65.85% of those residing in the rural area were married, and 55.81% ($p < 0.05$) of those in the urban area were widowed (Table 1).

Table 1: Distribution of elderly according to sociodemographic characteristics according to habitat.

Variables	Rural zone N = 41 (100.00%)	Urban zone N = 43 (100.00%)
Sex		
Male	16 (39.02)	7 (16.28)*
Female	25 (60.98)	36 (83.72)
Ethnicity/Skin color		
White	12 (29.27)	14 (32.56)
Brown	27 (65.85)	24 (55.81)
Black	2 (4.88)	4 (9.30)
Yellow	-	1 (2.33)
Marital status		
Married/stable union	27 (65.85)	8 (18.61)
Widower	10 (24.39)	24 (55.81)
Separated	1 (2.44)	8 (18.60)
Single	3 (7.32)	3 (6.98)
Educational level		
Illiterate	18 (43,90)	16 (37.21)
incomplete fundamental	21 (51,22)	25 (58.14)
Complete elementary	1 (2.44)	1 (2.33)
Incomplete high school	1 (2.44)	1 (2.33)
Per capita income		
Up to 1 minimum wage	40 (97.56)	41 (95.34)
More than minimum wage	1 (2.44)	1 (2.33)
Did not answer	-	1 (2.33)
Professional activity		
Retiree	41 (100)	40 (93.01)
Farmer	-	1 (2.33)
Hawker	-	1 (2.33)
Did not answer	-	1 (2.33)

*Means statistical difference verified by the Chi-square test, $p < 0.05$. Gender – p value = 0.0019; Marital status $p = 0.0001$.

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Arterial hypertension, which was the most reported health problem, affects 56.10% of the elderly in the rural area and 55.81% in the urban area. Only 26.83% of the elderly in the rural areas and 23.26% in the urban areas practiced physical exercise twice or more a week. More than 90% of the elderly in rural and urban areas did not consume alcoholic beverages.

No significant differences were found between the elderly in the rural area and those in the urban area regarding the presence of diseases (diabetes mellitus and arterial hypertension), the practice and frequency of physical activity, hospitalization in the last 30 days, the occurrence of falls and to alcohol use ($p > 0.05$), as shown in Table 2.

Elderly people living in rural areas stood out for having a lower percentage of smokers (7.32%) and a higher percentage (80.49%) of individuals who had good perceptions of their health condition ($p < 0.05$), when compared with residents in the urban area (Table 2).

Table 3 presents the distribution of elderly participants in the study, according to anthropometric measurements and parameters of respiratory muscle strength, considering the area of residence and gender.

BMI and maximal inspiratory and expiratory pressures did not differ between the analyzed groups ($p > 0.05$). It was found that the waist/hip ratio, for both sexes, was higher in the elderly in the rural areas ($p < 0.05$).

With regard to respiratory muscle strength, Figure 1 shows the comparison of the IP_{max} of the elderly participants in relation to their habitat. Women from urban areas have an average inspiratory force of 83.33 ± 2.031 cm H_2O, and those from rural areas have 83.2 ± 2.752 cm H_2O. As for EP_{max}, they present, respectively, 67.22 ± 1.809 cm H_2O and 66.4 ± 2.227 cm H_2O, but without statistical significance.

When comparing the respiratory muscle strength of the elderly in relation to their habitat, it was found that men in the urban area had an IP_{max} of 88.57 ± 5.948 cm H_2O, and those in the rural area, 87.5 ± 3.594 cm H_2O. Regarding the EP_{max} of the elderly in the urban area, they presented 68.57 ± 5.948 cm H_2O, and those in the rural area, 68.75 ± 3.146 cm H_2O, without statistically significant significance in the two variables evaluated (Figure 2).

Table 2: Characterization of the elderly in rural and urban areas according to the presence of diseases, behavioral habits, hospitalization, falls and health perception.

Variables	Rural zone N = 41 (100.00%)	Urban zone N = 43 (100.00%)
Diabetes mellitus		
Yes	5 (12.20)	7 (16.28)
No	36 (87.80)	36 (83.72)
Systemic arterial hypertension		
Yes	23 (56.10)	24 (55.81)
No	18 (43.90)	19 (44.19)
Practice of physical activity		
Yes	11 (26.83)	10 (23.26)
No	30 (73.17)	33 (76.74)
Frequency of physical activity		
Two or more times a week	11 (26.83)	10 (23.26)
Hospitalization in the last 30 days		
Yes	-	-
No	41 (100.00)	43 (100.00)
Fall		
Yes	5 (12.20)	2 (4.65)
No	36 (87.80)	41 (95.35)
Alcoholism		
Yes	1 (2.44)	3 (6.98)
No	40 (97.56)	40 (93.02)
Smoking		
smoker	3 (7.32)	12 (27.91)*
Ex-smoker	21 (51.22)	16 (37.21)
never smoked	17 (41.46)	15 (34.88)
Health Perception		
Good	33 (80.49)	22 (51.16)*
Regular	8 (19.51)	21 (48.84)

*Statistically significant difference verified by the Chi-square test, $p < 0.05$. Smoking – $p = 0.046$; Health perception – $p = 0.0049$.

Table 3: Comparison and characterization of the elderly according to anthropometric measurements and respiratory muscle strength according to place of residence and gender.

Variables	Rural zone		Urban area	
	Male N = 16	Female N = 25	Male N = 7	Female N = 36
BMI (Kg/m²)	25.36 (± 3.81)	26.18 (± 4.50)	26.77 (± 5.13)	24.88 (± 5.13)
Waist/hip ratio	0.98 (± 0.05)	0.94 (± 0.07)	0.91 (± 0.05)*	0.88 (± 0.08)*
$IP_{máx}$ (mmHg)	87.50 (± 14.37)	83.20 (± 13.76)	88.57 (± 15.73)	83.33 (± 12.19)
$EP_{máx}$ (mmHg)	68.75 (± 12.58)	66.40 (± 11.13)	68.57 (± 15.73)	66.67 (± 10.69)

Mean values (± SD) were described. *Statistical difference between the group of elderly people from rural x urban areas, considering the same sex, $p < 0.05$. *Statistical difference between males and females, considering the same area of residence, $p < 0.05$. Differences were analyzed using the ANOVA variance test, followed by the Tukey test. Waist/hip ratio *$p = 0.0115$ for males and $p = 0.039$ for females.

Discussion

The results of this research demonstrated that arterial hypertension is a health problem with the highest rate and that the practice of physical activity had the lowest percentage among the elderly in both areas of residence. The waist/hip ratio, for both sexes, was higher in the elderly in the rural area. With regard to respiratory muscle strength, the evaluated variables did not present a significant difference between the elderly.

With industrialization, the migration process took place, and Brazil, which had a rural population profile, now had the largest focus of households installed in cities. Due to this, the rural zone entered a process of abandonment, with little modernization, which culminated in exclusion. The population residing in these areas began to face difficulties that compromised their health and well-being and altered their socioeconomic profile [20].

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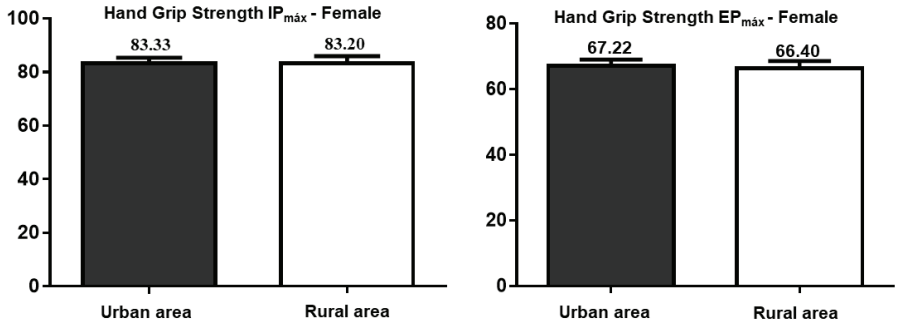

Figure 1: Distribution of elderly women in rural and urban areas according to respiratory muscle strength.

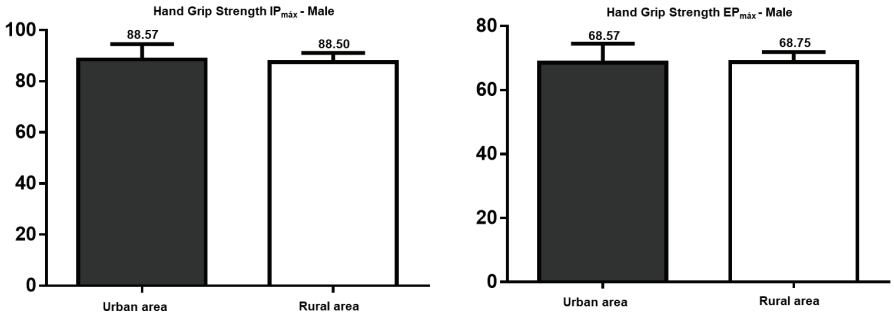

Figure 2: Distribution of elderly people in urban and rural areas according to respiratory muscle strength.

According to what is shown in the research, with regard to the analysis of sociodemographic aspects, women correspond to more than 70% of the elderly studied. These elderly people, in general, have little education (illiterate or incomplete elementary school), which suggests an unfavorable socioeconomic situation, and their main source of income is retirement. Despite the notorious increase in longevity, the number of elderly people who live with their children remains high. This reflects the reality of many developing countries [14].

The rural zone has the highest number of elderly women due to the rural-urban male migration of young adults who are in the productive phase. This is a movement rooted in socioeconomic and cultural dynamics, which leads to a greater number of these elderly women. The longer life expectancy among women is also due to taking care of their own health and less exposure to risk factors [20].

According to the research, arterial hypertension is the disease that most affects the participants, which corroborates the result of a study [21] that demonstrated that the prevalence of arterial hypertension in elderly residents in Brazil, by age group, is 44.4%, from 60 to 64 years old; 52.7%, from 65 to 74 years old; and 55.5%, aged 75 or over. Aging causes physiological and anatomical changes that make the elderly more vulnerable to health problems and some type of morbidity [6].

Physical activity practiced regularly by the elderly improves the quality of their life, promotes a greater sense of self-efficacy, and makes them more motivated, in addition to reducing the likelihood of developing chronic diseases and increasing their general disposition and physical fitness. However, the research showed a low adherence of the elderly in both habitats to the practice of physical activities [22].

In old age, a good quality of life can be seen as the sum of health, social, economic, environmental, cultural, and political conditions that are available to individuals to realize their potential. In rural areas, the elderly had better subjective quality of life indices, as they had more contact with their peers and a larger neighborhood network, reinforcing personal interaction and maintaining affective bonds. This is in line with the data obtained in the research, in which the elderly in the rural area portray better perceptions about their health situation [23].

Regarding eating habits, it is common to observe, among Brazilians, the consumption of processed foods, a factor that is directly related to overweight and metabolic disorders that are increasingly frequent. The consumption of these processed and ultra-processed foods by the elderly in rural areas represents 30.28% of the total energy value of the diet, which contributes to the increased risk of obesity, diabetes, cardiovascular diseases, and some types of cancer. This justifies the higher waist/hip ratio presented in the rural population of the research [24].

Still regarding the body composition of the elderly, another aspect that changes during aging is the redistribution of body fat from the extremities to the visceral area, which can interfere with the respiratory system [18]. Aging favors the loss of mass, strength, and muscle function, even in the healthy elderly. It has a direct correlation with the respiratory muscles

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and can interfere with the functional capacity and performance of activities of daily living, which is considered a significant factor in the loss of independence in this age group [25].

The aging of the respiratory system reduces the number and thickness of elastic fibers and the compliance of the chest wall caused by the fusion of bony and cartilaginous elements. This interferes with respiratory mechanics, reduces expandability, and as an aggravating factor, decreases the strength of the respiratory muscles [26].

Studies show that there is a relationship between age group and a significant reduction in IP_{max} and EP_{max}. This reduction is about 15% of muscle strength every decade. Factors such as the decrease in muscle mass and muscle fibers, especially type II, and the reduction in lung elasticity and compliance of the rib cage compromise respiratory capacity [6]. According to Pereira, et al. [27], there is evidence that sarcopenia can also affect the respiratory muscles in such a way as to impact strength, volume, and lung capacity, which may favor the risk of respiratory diseases.

It would likely be that the elderly living in rural areas could be correlated with a reduction in respiratory muscle strength. However, there was no significant difference between the evaluated groups, that is, all studied groups had similar IP_{max} and EP_{max} values. When the values in percentage for the EP_{max} were verified, both groups presented reduced values. The impairment of the expiratory muscles decreases the flow and impairs the cough mechanism, predisposing to the accumulation of secretions and the development of bronchopulmonary infections [25].

The function of the muscles that make up the respiratory system undergoes a decline and leads to a progressive decrease in lung expansion and ineffective ventilation. The decrease in IP_{max} values is caused by the limitation in sitting, standing up, and squatting activities and the decrease in IP_{max} values is caused by the limitation of balance [26].

A sedentary lifestyle and aging can aggravate the reduction in inspiratory and expiratory muscle strength, consequently reducing intrathoracic pressure and expiratory flow during coughing, which is why physical activity is so important to maintain the strength of these muscles because it improves protection mechanisms of the airways since the gain in strength contributes to increasing the effectiveness of the cough [9].

The regular practice of physical exercises is one of the ways to reduce the physiological pulmonary complications resulting from aging, such as the decrease in aerobic capacity and the weakening of the respiratory muscles, and to improve the lives of elderly individuals [28].

During the research, some factors contributed to the selection of collection sites, such as shorter distances and easier access. The agenda of the collection site was also an important factor for the sample size, as it resulted in losses during the application of the questionnaires and the performance of the respiratory strength tests since the elderly did not always attend the meetings.

It should be noted that, among the limitations faced in the development of this study, the difficulty of finding studies in Brazil that have compared respiratory muscle strength in the elderly between urban and rural environments stands out.

Conclusion

Elderly people living in rural areas who participated in this study had a lower percentage of smokers and a higher waist/hip ratio for both sexes. On the other hand, both habitats presented high blood pressure as a health problem with the highest index. With regard to respiratory muscle strength, the evaluated variables did not show statistically significant relevance.

The aging process causes a physiological decrease in RMS. For this reason, preventive measures are necessary since the decrease in muscle strength related to age can predispose these elderly people to the appearance of respiratory and chronic degenerative diseases, which compromise the quality of their life and contribute to the loss of functional autonomy.

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Citation: Nóbrega MG, Andrade Feitosa ADN, de Lira RC, de Assis EV, Ferreira SB, et al. (2023) Influence of geographical space on the strength of the breathing muscles of elderly residents in the rural and urban areas of the high hinterland of Paraiba. J Nov Physiother Phys Rehabil 10(2): 022-028.
DOI: https://dx.doi.org/10.17352/2455-5487.000101