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ORIGINAL ARTICLE

Geriatrics, Gerontology and Aging

Multimorbidity is associated with low functional ability in older adults living in a German-colonized city in southern Brazil: a population-based study

Multimorbidade está associada à baixa capacidade funcional em idosos moradores de uma cidade colonizada por alemães no sul do Brasil: um estudo de base populacional

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Abstract

Objective: To analyze the association between multimorbidity and low functional ability in older adults in southern Brazil.

Methods: In a cross-sectional population-based study, we analyzed a sample of 435 persons aged 60–79 years old. Functional ability was estimated using a scale 0 to 100, stratified into quartiles, and the presence of diseases was self-reported. The association between multimorbidity and low functional ability (lowest quartile or less) was estimated by logistic regression.

Results: The frequency of multimorbidity was 85.5% and the median functional ability score was 70. There was an inverse correlation between functional ability score and the number of chronic diseases (rho= -0.48; p<0.0001). Low functional ability was associated with multimorbidity (OR 3.1; 95%CI 1.7–5.5; p<0.001) and remained so after adjustment for sex, age, health service utilization, hospitalizations, health insurance status, and self-perceived health status (OR 2.0; 95%CI 1.07–3.73; p=0.029).

Conclusion: Identifying the most vulnerable older adults and providing them with appropriate health care could help prevent loss of functional ability.

Keywords: healthy aging; multimorbidity; physical functional performance; personal autonomy.

INTRODUCTION

Functional ability in people aged 60 and older refers to the decision-making autonomy and physical independence to perform activities in the community.[1] Studies have shown[2,3] that functional ability may be limited by advancing age and the onset of one or more diseases. Thus, a decrease in functional ability with aging may be associated, in whole or in part, with genetic inheritance mediated by environmental and social factors.[4,5]

Multimorbidity, defined as the co-occurrence of two or more chronic conditions,[6] occurs with varying frequency in older adults around the world. A recent systematic review of 193 studies from five continents obtained a prevalence of multimorbidity of 42.0%, which increased with age and the number of conditions analyzed.[7] One study found an increase in the prevalence of multimorbidity from 38.2 to 41.5% between 2006 and 2015 in 10 Central European countries, including France and Germany.[8] In Brazil, nationwide population-based studies found prevalences between 52.0%[9] and 67.0%,[10] with differences between regions.

Multimorbidity is associated with reduced functional ability.[5] Progressive worsening of functional capacity has been observed, particularly in women and those older than 75 years, as the number of comorbidities increases.[3] A study conducted in six middle- and low-income countries with diverse ethnic backgrounds found an association of multimorbidity with limitations in activities of daily living (ADL) and poorer self-perceived health, with a greater impact among those in poorer socioeconomic conditions.[11] A national population-based study found a prevalence of 23.4% of ADL difficulties associated with the presence of multimorbidity.[4]

Brazil has a population with diverse genomic ancestry, with a European predominance in the south of the country[12] as a result of several waves of migrants from Portugal, Italy, and Germany, who brought their own customs and cultures. Ethnic and cultural factors can drive situations of vulnerability and inequality related to the way human communities get sick and die.[13] Some studies have shown such differences in specific populations, especially among indigenous peoples[14] and those of African descent.[15,16] However, to the best of our knowledge, there are no studies investigating the association between multimorbidity and functional ability in specific populations.

The aim of this study is to analyze the association between multimorbidity and low functional ability in people aged 60 years or older living in Pomerode (SC), Brazil, a population of predominantly German descent.

METHODS

This is a population-based cross-sectional study of participants from the baseline of the "Study of Health in Pomerode" (SHIP-Brazil) cohort. SHIP-Brazil is a sister study derived from the Study of Health in Pomerode (SHIP) conducted in Germany; its aims and methods have been described in detail elsewhere.[17]

Pomerode (SC) is located in Southern Brazil (geographical coordinates: 26° 44′ 27″ S and 49° 10′ 33″ W). Its population (2017 estimate: 33 447) consists largely of descendants of German immigrants who came from Pomerania around 1863, and it has a Human Development Index (HDI) of 0.987.[18]

SHIP-Brazil included people who had lived in Pomerode (SC) for at least 6 months. People with physical or mental disorders that prevented them from answering the questionnaires or completing the tests were excluded. A stratified random sample of 3678 people of both sexes, aged 20 to 79 years, was drawn. The final sample size was 2488 people. For the present study, the sample consisted of people aged 60 to 79 years of both sexes (n = 733).

SHIP-Brazil complies with the Declaration of Helsinki and was approved by the relevant institutional Research Ethics Committee. All participants provided written informed consent prior to participation and agreed to the publication of anonymized information.

Information on sociodemographic variables, lifestyle, and medical history was collected by trained personnel during standardized face-to-face interviews in the participants' homes, using structured questionnaires. The functional ability questionnaires and the physical performance and muscle strength tests were administered in the Examination Center at the University Hospital; results were monitored weekly. All data collection was done from 2014 to 2018.

The first block of the SF-36 (Medical Outcomes Study 36 Item Short-Form Health Survey) questionnaire, adapted and validated for Portuguese,[19] was used to estimate functional ability. This instrument consists of 10 questions related to basic and instrumental ADLs, preceded by the question "Do you have difficulty performing these activities because of your health condition?" Respondents were given 3 response options on a Likert scale where they defined the level of difficulty in performing each activity. The resulting score was summed and converted into a scale ranging from 0 (lowest functional ability) to 100 (highest functional ability). The internal consistency of the questionnaire applied to this population was found to be excellent (Cronbach's alpha =0.89).

To characterize multimorbidity, the presence of 28 clinical conditions reported by participants was assessed:

hypertension, angina, myocardial infarction, atrial fibrillation, stroke, congestive heart failure, diabetes mellitus, lower extremity varicose veins, chronic lung disease (bronchitis or emphysema), kidney disease, degenerative osteoarthritis, inflammatory polyarthropathy, osteoporosis, hepatitis, cirrhosis, osteoporosis, hepatitis, cirrhosis, hepatic steatosis, cholecystitis or cholelithiasis, dyslipidemia, gout or hyperuricemia, urinary tract infection, prostate disease, thyroid disease, Parkinson's disease, depression, or cancer. All were asked whether "a doctor or health professional has told you that you have any of the following conditions". The interviewers used synonyms or more accessible language, defined a priori in the questionnaire, to facilitate respondents' understanding. Answers were taken to indicate presence or absence. From these data, two variables were created: 1. the number of conditions/diseases, given by the sum of the listed conditions reported as present; and 2. multimorbidity, an ordinal categorical variable assigned a value of "0" if the respondent denied all the conditions mentioned, "1" if only one condition was present, and "2" if two or more conditions were present (multimorbidity).

The following further variables were examined: sex assigned at birth (male/female), age (in completed years), marital status (married or single/separated/widowed), and race/skin color (white or other), all self-reported. Germanic culture (yes/no) was ascribed to those who regularly speak German at home and participate in Germanic cultural associations.[20] Tobacco use was classified as current smoker, former smoker, or never smoker. Alcohol intake was assessed using the AUDIT-C questionnaire, adapted and validated for Portuguese[21]; participants were then classified into low or and moderate/high/severe risk. Educational attainment was estimated based on years of completed schooling and grouped into 0 to 4 years, 5 to 8 years, 9 to 11 years, and 12 or more years.

Participants were also asked about their self-perceived health status (very good/good, fair, poor/very poor), use of any health service in the last 30 days (yes/no), and hospital stay in the last 12 months (yes/no), as well as whether they had any type of health insurance (yes/no).

Physical performance was assessed using the Timed Up and Go test.[22] This is based on the time taken to get up from a chair, walk 3 m, turn around, and sit down again. Each participant was asked to perform the test three consecutive times and the shortest time in seconds was considered for analysis.

Handgrip strength (a surrogate of muscle strength) was measured with a Jamar Digital Dynamometer (Patterson Medical, Sammons Preston, Bolingbrook, USA) in kilograms (kg). The participant was instructed to perform three trials with each hand in a maximal isometric contraction. The highest value of the six measurements taken was used.[23]

A Brazilian validated version of the International Physical Activity Questionnaire (IPAQ – short version) was used to assess physical activity,[24] taking into account frequency, duration in minutes, and intensity over the past 7 days. Those who reported doing moderate or vigorous physical activity for 150 minutes or more per week were considered sufficiently active.

Statistical analysis

Data were analyzed using descriptive statistics and presented in tabular and/or graphical form. Variables were tested for normality of distribution. The association between the number of comorbidities and the functional ability score was estimated by Spearman correlation (rho). Associations between functional ability (categorized into quartiles) and the other study variables were tested using the Kruskal-Wallis method (with Dunn's post-hoc test) for continuous variables or Pearson's χ^2 for frequencies. Functional ability was then transformed into a dichotomous variable, with the lowest quartile as the cut-off point for estimating low functional ability.

The association between multimorbidity (presence vs. absence of 2 or more diseases) and low functional ability was estimated by logistic regression (crude and adjusted by blocks):

1. Sex and age;
2. Sex, age, muscle strength, and physical performance;
3. Sex, age, and sociodemographic and lifestyle variables;
4. Sex, age, and care variables.

The goodness of fit of the models was estimated by the Hosmer–Lemeshow test. P-values < 0.05 were considered statistically significant. All analyses were performed in Stata 11.2 (Stata Corporation, College Station, TX, USA).

This study was conducted and reported following the STROBE guidelines. The completed STROBE checklist is provided as a supplementary file.

RESULTS

Of the 733 participants selected and interviewed, 188 did not attend the Examination Center (refusals) and 110 had missing data for one or more variables (loss) and were therefore excluded from the analysis. Table 1 shows the characteristics of the participants overall and in terms of the number of comorbidities reported.

Most of the participants reported having two or more of the diseases of interest, characterizing multimorbidity.

TABLE 1. Characteristics of the participants and number of self-reported chronic diseases (n = 435).

Variables	Total (%)	Self-reported chronic diseases			p-value
		None (%)	One (%)	Two or more (%)	
Sex					
Male	204 (46.9)	15 (68.2)	27(65.8)	162 (43.5)	0.003*
Female	231 (53.1)	7 (31.8)	14 (34.2)	210 (56.5)	
Age (in years)					
Median (IQR)	66.6 (63.2–71.7)	63,8 (61.6–70.4)	68,6 (63.8–72.4)	66,7 (63.3–71.6)	0.094*
Marital status					
Married	330 (76.1)	17 (77.2)	26 (63.4)	287 (77.4)	0.138*
Single/Separated/ Widowed	104 (23.9)	5 (22.8)	15 (36.6)	84 (22.6)	
Race/skin color					
White	419 (96.5)	22 (100.0)	40 (97.6)	357 (96.3)	0.598*
Non-white	15 (3.5)	0 (0)	1 (2.4)	14 (3.7)	
Germanic culture					
Yes	376 (86.9)	17 (80.9)	33 (80.5)	326 (87.9)	0.297*
No	57 (13.1)	4 (19.1)	8 (19.5)	45 (12.1)	
Educational attainment (years completed)					
12 or more	14 (3.3)	0 (0)	2 (5.0)	12 (3.3)	0.161*
9 to 11	23 (5.4)	3 (14.3)	4 (10.0)	16 (4.4)	
0 to 8	386 (91.2)	18 (85.7)	34 (85.0)	334 (92.3)	
Tobacco use					
Never smoked	245 (56.5)	9 (40.9)	16 (40.0)	220 (59.1)	0.022*
Former smoker	134 (30.9)	8 (36.4)	14 (35.0)	112 (30.1)	
Current smoker	55 (12.6)	5 (22.7)	10 (25.0)	40 (10.8)	
Alcohol intake					
Low	354 (81.8)	13 (59.1)	26 (65.0)	315 (84.9)	< 0.001*
Moderate/High/Severe	79 (18.2)	9 (40.9)	14 (35.0)	56 (15.1)	
Physical activity					
Sufficiently active	271 (64.6)	19 (86.3)	30 (76.9)	222 (62.0)	0.017*
Insufficiently active	148 (35.3)	3 (13.6)	9 (23.1)	136 (38.0)	
Self-perceived health status					
Good/good	183 (42.1)	16 (72.7)	27 (65.8)	140 (37.7)	<0.001*
Fair	212 (48.8)	6 (27.2)	14 (34.1)	192 (51.7)	
Poor/Very poor	39 (8.9)	0 (0)	0 (0)	39 (10.5)	
Health service utilization					
Yes	184 (42.6)	5 (23.8)	8 (19.5)	171 (46.3)	< 0.001*
No	247 (57.3)	16 (76.1)	33 (80.4)	198 (53.7)	
Hospitalization in the last year					
Yes	32 (7.6)	0 (0)	3 (7.6)	29 (8.1)	0.381*
No	387 (92.4)	22 (100)	36 (92.4)	329 (91.9)	
Private health insurance					
Yes	164 (37.9)	1 (4.5)	8 (19.5)	155 (42.0)	< 0.001*
No	268 (62.1)	21 (95.5)	33 (80.5)	214 (58.0)	
Handgrip strength (kg)					
Median (IQR)	28.6 (22.9–37.9)	35.5 (29.3–41.5)	35.7 (26.0–41.9)	27.7 (22.4–36.9)†	< 0,001
Timed Up and Go test performance (seconds)					
Median (IQR)	10 (9–12)	9 (8–10)	9 (9–11)	10 (9–12)†	< 0,001

*Pearson's χ^2 test; †Kruskal-Wallis test and Dunn's post-hoc test

This condition was more common in female older adults, who were insufficiently active, had a self-perceived health status of fair or poor/very poor, had used health services in the last 30 days, and had private health insurance. In addition, multimorbidity was more prevalent in older adults who had both lower muscle strength and poorer physical performance.

Table 2 shows the degree of ADL limitation reported by participants. Activities such as "bowing, kneeling, or bending down" and "walking several blocks" were worse (very limited) in women than in men, with a difference of 21.0 and 20.7 percentage points respectively. In relative terms, "walking one block" (2.3) and "walking several blocks" (2.1) were the activities with the highest scores, also showing a worse scenario for women.

The participants' median functional ability, estimated on a scale from 0 to 100, was 70 (higher in men than women; 80 vs 60, $p < 0.0001$). A negative correlation (rho = -0.48) was observed between the number of reported chronic diseases and the functional ability scale.

Table 3 shows that respondents with lower functional ability (quartile 1) were more likely to be female (71.9 vs 40.3%, $p < 0.001$), insufficiently active (48.3 vs 24%, $p = 0.002$), have a lower risk of moderate/high/severe alcohol consumption (8.3 vs 30.8%, $p < 0.001$), report a poor/very poor self-perceived health status (21.7 vs. 3.8%, $p < 0.001$), higher proportion of multimorbidity (97.5 vs. 74%, $p < 0.001$), lower mean muscle strength (24.8 kg vs. 32.6 kg, $p < 0.001$), and worse physical performance (11.5 s vs. 9 s, $p < 0.001$) compared to the group with better functional ability (quartile 4).

The results of the logistic regression models, crude and adjusted for the presence of multimorbidity and functional ability (dichotomous), are shown in Table 4. Multimorbidity was associated with a threefold increase in the odds of having reduced functional ability in the crude analysis, but this effect was reduced to a twofold increase after adjustment (Model 4).

Figure 1 shows the percentage of morbidity reported per functional ability quartile and the absolute and relative differences between quartile 1 (worst functional ability) and quartile 4 (best functional ability).

Bone diseases such as degenerative osteoarthritis and inflammatory polyarthropathy were associated with the largest differences between the worst and best functional ability quartiles; osteoporosis and inflammatory polyarthropathy had the highest relative values between quartiles 1 and 4. Other conditions are presented in the supplementary material (Figure 1).

TABLE 2. Percentage of limitations in some activities of daily living by sex and their absolute (differences) and relative (ratio) variations (n = 435).

Activities	Male			Female			Difference and ratio between very limited and no limitation (female/male)	
	Limitation (%)			Limitation (%)			Difference	Ratio
	Very	Little	None	Very	Little	None		
Vigorous activities that require a lot of effort	32.3	38.2	29.4	50.2	32	17.7	17.9	1.6
Bowing, kneeling, or bending down	23.5	35.2	41.1	44.5	27.2	28.1	21.0	1.9
Walking several blocks	18.6	31.8	49.5	39.3	27.7	32.9	20.7	2.1
Climbing several flights of stairs	18.6	29.9	51.4	36.8	28.1	35	18,2	2.0
Walking more than one kilometer	16.1	20.5	63.2	30.3	21.6	48	14.2	1.9
Lifting or carrying supplies	16.1	25	58.8	25.9	26.8	47.1	9.8	1.6
Moderate activities, such as moving a table	13.7	29.9	56.3	20.3	35	44.5	6.6	1.5
Walking a block	7.8	23.5	68.6	18.1	25.9	55.8	10.3	2.3
Climbing a flight of stairs	6.8	20.5	72.5	11.2	26.4	62.3	4.4	1.6
Bathing or dressing	4.4	8.3	87.2	5.1	14.7	80	0.7	1.2

TABLE 3. Functional capacity (in quartiles) and study variables (n = 435).

	Functional capacity				p-value
	Q1 = 45 (%)	Q2 = 70 (%)	Q3 = 85 (%)	Q4 = 100 (%)	
Sex					
Male	34 (28.1)	45 (49.5)	63 (52.9)	62 (59.6)	0.001*
Female	87 (71.9)	46 (50.5)	56 (47.1)	42 (40.4)	
Age (years)	67.1	66.9	66.2	65.2	
Median (interquartile range)	(63.7–72.8)	(63.7–72.7)	(62.8–70.8)	(62.7–70.4)	0.183*
Marital status					
Married	95 (78.5)	71 (78.1)	87 (73.7)	77 (74.0)	0.759*
Single/Separated/Widowed	26 (21.5)	20(21.9)	31 (26.3)	27(26.0)	
Race/skin color					
White	117 (96.7)	87 (95.6)	114 (96.6)	101 (97.1)	0.950*
Non-white	4 (3.3)	4 (4.4)	4 (3.4)	3 (2.9)	
Germanic culture					
Yes	106 (87.6)	78 (85.7)	102 (87.2)	90 (86.5)	0.980*
No	15 (12.4)	13 (14.3)	15 (12.8)	14 (13.5)	
Educational attainment (years completed)					
12 or more	1 (0.8)	2 (2.4)	5 (4.4)	6 (5.8)	
9 to 11	3 (2.5)	4 (4.8)	8 (6.9)	8 (7.7)	0.179*
0 to 8	116 (96.7)	78 (92.8)	102 (88.7)	90 (86.5)	
Tobacco use					
Never smoked	79 (65.3)	45 (49.5)	67 (56.8)	54 (51.9)	
Former smoker	26 (21.5)	34 (37.4)	39 (33.0)	35 (33.7)	0.181*
Current smoker	16 (13.2)	12 (13.1)	12 (10.2)	15 (14.4)	
Alcohol intake					
Low	111 (91.7)	76 (84.4)	95 (80.5)	72 (69.2)	< 0.001*
Moderate/high/severe	10 (8.3)	14 (15.6)	23 (19.5)	32 (30.8)	
Physical activity					
Sufficiently active	61 (51.7)	59 (68.6)	75 (65.2)	76 (76.0)	0.002*
Insufficiently active	57 (48.3)	27 (31.4)	40 (34.8)	24 (24.0)	
Self-perceived health					
Good/Very good	20 (16.6)	28 (30.8)	66 (55.5)	69 (66.4)	
Fair	74 (61.7)	57 (62.6)	50 (42.0)	31 (29.8)	< 0.001*
Poor/Very poor	26 (21.7)	6 (6.6)	3 (2.5)	4 (3.8)	
Health service utilization					
Yes	57 (48.3)	37 (40.7)	51 (43.2)	39 (37.5)	0.418*
No	61 (51.7)	54 (59.3)	67 (56.8)	65 (62.5)	
Hospitalization in the last year					
Yes	12 (10.5)	7 (8.1)	10 (8.7)	3 (2.9)	0.186*
No	102 (89.5)	80 (91.9)	105 (91.3)	100 (97.1)	
Private health insurance					
Yes	55 (46.6)	36 (39.6)	38 (31.9)	35 (33.7)	0.090*
No	63 (53.4)	55 (60.4)	81 (68.1)	69 (66.3)	
Number of diseases					
None	0 (0)	2 (2.2)	8 (6.7)	12 (11.5)	
One	3 (2.48)	6 (6.6)	17 (14.3)	15 (14.4)	< 0.001*
Two or more	118 (97.5)	83 (91.2)	94 (79.0)	77 (74)	
Handgrip strength (kg)	24.8†	29.7	30.8	32.6	< 0.001
Median (IQR)	(21.5–29.3)	(23.4–39.9)	(22.7–37.8)	(26.0–43.0)	
Timed Up and Go test performance (s)	11.5†	10	10	9	< 0.001
Median (IQR)	(10–13)	(9–11)	(9–11)	(8–10)	

Functional capacity: 0 to 100; Q: Quartile.
*Pearson's χ^2 test; †Kruskal-Wallis test and Dunn's post-hoc test.

TABLE 4. Odds ratios and respective 95% confidence intervals of the crude and adjusted logistic regression models of multimorbidity and functional capacity.

Model	Odds ratio (95%CI)	p-value
Crude	3.1 (1.7 – 5.5)	< 0.001
Model 1	2.8 (1.6 – 5.1)	< 0.001
Model 2	2.3 (1.2 – 4.2)	0.008
Model 3	2.4 (1.3 – 4.5)	0.005
Model 4	2.0 (1.1 – 3.7)	0.029

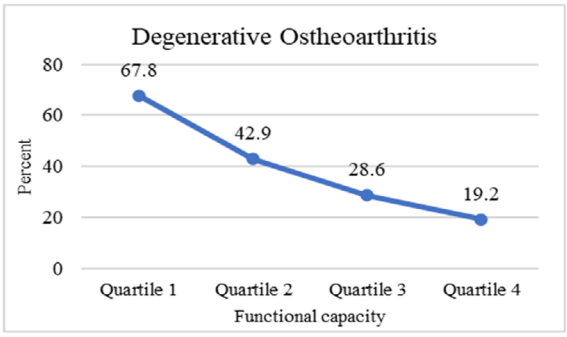
Model 1: sex and age; maximum likelihood ratio (MLR): 46.48; Hosmer-Lemeshow goodness of fit (GOF): 2.92, p = 0.93. Model 2: sex, age, muscle strength, physical performance; MLR: 90.09; GOF: 11.00, p = 0.20. Model 3: sex, age, marital status, skin color, socioeconomic status, smoking, alcohol intake, physical activity; MLR: 68.57; GOF: 5.66, p = 0.68. Model 4: sex, age, health services utilization, hospitalizations, health insurance, self-perceived health. MLR: 91.36; GOF: 13.17, p = 0.10.

DISCUSSION

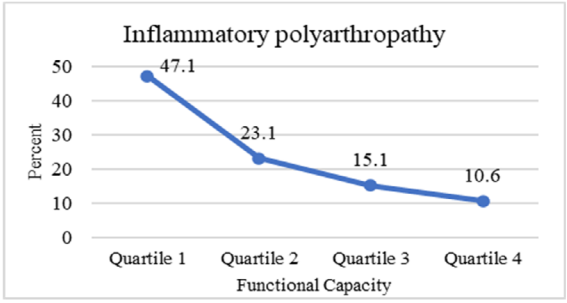
Our findings suggest that some ADLs such as "bowing, kneeling, or bending down" and "walking several blocks" were difficult to perform, more so for women. Musculoskeletal conditions showed a strong association with low functional ability. People had lower functional ability when they were older, female, insufficiently active, had less strength, poorer physical performance, worse self-perceived health status, and two or more reported comorbidities. Multimorbidity was associated with low functional ability, even after adjustment for several confounders.

The average functional ability of the participants, estimated on a scale of zero to 100, was good (median = 70). High-quality public services contribute to an older population with better functional ability in areas with lower income inequality.[25] One study[5] found a negative gradient in the association between schooling and functional ability (cognition/physical status). Pomerode (SC) has high socioeconomic indicators (HDI, income per capita) and a robust urban infrastructure, which, combined with the high proportion of people with good socioeconomic conditions,[18] may have contributed to the maintenance of functional ability among older adults living there.

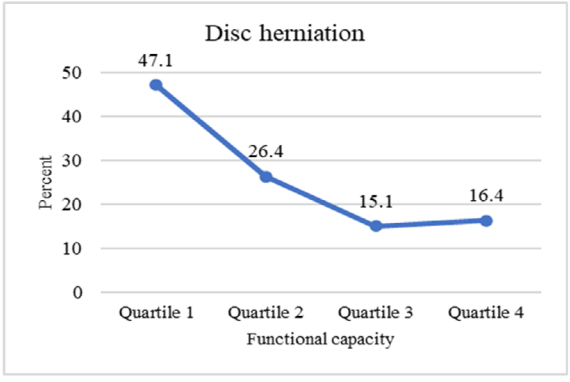
Some ADLs were reported to be more difficult to perform, especially more vigorous ones that involved walking longer distances. The decline in muscle strength and endurance that accompanies the aging process, combined with an insufficient level of physical activity,[26] may explain these reported limitations at least in part. On the other hand, a systematic review of 27 studies found that physical exercise,



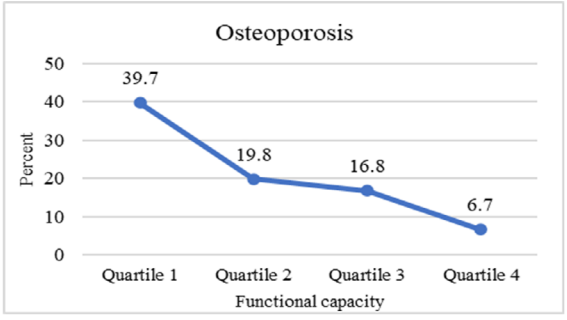
Quartile 1 – Quartile 4= 48.6; Quartile 1 / Quartile 4= 3.5; p<0.001



Quartile 1 – Quartile 4= 36.5; Quartile 1 / Quartile 4= 4.4; p<0.001



Quartile 1 – Quartile 4= 30.7; Quartile 1 / Quartile 4= 2.9; p<0.001



Quartile 1 – Quartile 4= 33; Quartile 1 / Quartile 4= 5.9; p<0.001

FIGURE 1. Proportion of self-reported morbidity by quartile of functional capacity and differences and ratio between quartiles 1 (worst) and 4 (best).

especially multifunctional training, can improve muscle strength and physical performance.[27] In Brazil, this type of exercise, which requires little equipment, could be an alternative to be implemented in primary care under the supervision of physical activity specialists.

Osteoarthritis, arthritis, osteoporosis, and disc herniation were the reported conditions associated with the greatest absolute variation between the lowest and highest functional ability quartiles. The presence of musculoskeletal conditions can lead to reduced muscle strength and, consequently, reduced functional ability in people aged 60 and older. These conditions, particularly osteoarthritis and polyarthritis, mainly affect basic ADLs.[28] In this sense, musculoskeletal conditions can create a negative cycle of increased risk of frailty, increased risk of falls, fractures, and increased comorbidities.

Women reported more limitations in performing ADLs, a finding consistent with Brazilian[3] and international studies.[29] Among the explanatory hypotheses, the authors mention lower muscle strength than men and socioeconomic differences that have been more unfavorable to women over the years, who have a higher prevalence of morbidity.[3,29] This may explain, at least in part, their greater difficulty with ADLs, particularly those that require greater physical strength.

Low functional ability was associated with insufficient physical activity. There is a strong association with loss of physical function, which can lead to social isolation, mobility impairment, loss of functional ability, and deterioration in quality of life.[30] Insufficient practice of moderate or vigorous physical activity can lead to a range of losses, including reduced muscle mass, reduced strength, loss of balance, risk of falls, loss of autonomy, and functional decline.[31] Regular physical activity is a protective factor for maintaining functional ability and reducing the risk of comorbidities.

In our study, being of Germanic culture did not affect the association between multimorbidity and low functional capacity. This can be explained, at least in part, by the sample size (study power) and the homogeneity of the study population (87% reported being of Germanic culture).

The strength of the association between multimorbidity and low functional capacity decreased depending on the model analyzed, with greater adjustment observed in the model that included sex, age, health service utilization, hospitalization, health insurance status, and self-perceived health status. Poor/very poor self-perception of health has been shown to be associated with multimorbidity[11] and functional ability.[32] Negative self-perceived health is associated with a higher demand for medical consultations.[33] On the other hand, the use of health services, here including home visits and hospitalizations, has been associated with a greater decline in functional ability in Brazil.[34] Health services play an important role in managing the care of older adults, which includes ensuring access to professionals and supplies in quantity and quality appropriate to the needs of their patients. A systematic review showed that health interventions provided to people with multimorbidity can improve self-perceptions of health, in addition to reducing anxiety and depression.[35] Therefore, it is hypothesized that the role of multimorbidity in reducing functional ability may be mitigated if people have access to health services that provide appropriate care and promote a positive self-perception of health.

Study limitations

This study has the limitations inherent to cross-sectional designs, such as reverse causality, which could explain at least in part the association found between moderate to high alcohol intake and better functional ability. Another limitation is the difficulty of making comparisons with other studies both because of the variety of instruments used to assess functional ability and due to the concept of multimorbidity (presence of two or more diseases and which of these diseases to consider). Finally, selection bias due to losses and refusals is to be expected. There was a higher proportion of older adults with poor socioeconomic status among the non-participants, which may have attenuated the associations found in our study.

CONCLUSIONS

There is an association between multimorbidity and low functional ability among older adults in Pomerode (SC), Brazil. Functional ability was lowest among women, people over 65 years of age, people who are inactive, people who rate their general health as poor, and people with two or more reported chronic conditions (especially musculoskeletal).

This study employed low-cost, easy-to-use research methods, including questionnaires and a limited range of physical tests, which can be carried out in specialized centers but also in primary care facilities of the Brazilian Unified Health System. Identifying those most at risk can help prevent loss of functional ability and reduce harm through appropriate individual and collective care.

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DECLARATIONS

Conflict of interest
The authors declare no conflicts of interest.

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Authors contributions
Ernani Tiaraju de Santa Helena: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, writing – original draft, writing – review & editing. Pedro Henrique Ferreira de Souza Trindade: conceptualization, formal analysis, writing – original draft, writing – review & editing. Fernanda Nunes Barbosa: conceptualization, formal analysis, writing – original draft, writing – review & editing. Ana Beatriz dos Santos: conceptualization, writing – review & editing. Cleide Gessele: conceptualization, writing – review & editing. Clóvis Arlindo de Sousa: conceptualization, formal analysis, investigation, project administration, supervision, writing – review & editing. Henry Völzkec: conceptualization, supervision, writing – review & editing. Marcello Ricardo Paulista Markus: conceptualization, supervision, writing – review & editing.

Ethical approval and informed consent
SHIP-Brazil was approved by the Ethics Committee of the University of Blumenau (CAAE: 99559118.0.0000.5370) and complies with the Helsinki Declaration and Resolution 510/2016 of the Brazilian National Health Council.

Data availability statement
The data that support the findings of this study are available from the SHIP-Brazil Steering Committee at www.furb.br/vspomerode. Some restrictions apply.

Reporting standards guidelines
We adopted the STROBE guideline recommendations for reporting of observational studies.

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