CLINICAL RESEARCH STUDY

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Walking Speed Drives the Prognosis of Older Adults with Cardiovascular and Neuropsychiatric Multimorbidity

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ABSTRACT

BACKGROUND: We investigated the impact of multiple cardiovascular and neuropsychiatric diseases on all-cause and cause-specific mortality in older adults, considering their functional status.

METHODS: This cohort study included 3241 participants (aged ≥60 years) in the Swedish National study of Aging and Care in Kungsholmen (SNAC-K). Number of cardiovascular and neuropsychiatric diseases was categorized as 0, 1, or ≥2. Functional impairment was defined as walking speed of <0.8m/s. Death certificates provided information on 3- and 5-year mortality. Hazard ratios (HR) were derived from Cox models (all-cause mortality) and Fine-Gray competing risk models (cardiovascular and non-cardiovascular mortality).

RESULTS: After 3 years, compared with participants with preserved walking speed and without either cardiovascular or neuropsychiatric diseases, the multivariable-adjusted HR (95% confidence interval) of all-cause mortality for people with functional impairment in combination with 0, 1, and ≥2 cardiovascular diseases were 1.88 (1.29-2.74), 3.85 (2.60-5.70), and 5.18 (3.45-7.78), respectively. The corresponding figures for people with 0, 1, and ≥2 neuropsychiatric diseases were, respectively, 2.88 (2.03-4.08), 3.36 (2.31-4.89), and 3.68 (2.43-5.59). Among people with ≥2 cardiovascular or ≥2 neuropsychiatric diseases, those with functional impairment had an excess risk for 3-year all-cause mortality of 18/100 person-years and 17/100 person-years, respectively, than those without functional impairment. At 5 years, the association between the number of cardiovascular diseases and mortality resulted independent of functional impairment.

CONCLUSIONS: Functional impairment magnifies the effect of cardiovascular and neuropsychiatric multimorbidity on mortality among older adults. Walking speed appears to be a simple clinical marker for the prognosis of these two patterns of multimorbidity.

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INTRODUCTION

Chronic diseases and functional decline are major impediments to health maintenance in older age.[1–5] Fifty-five to 98% of older adults have 2 or more diseases, a phenomenon known as multimorbidity, which is the most frequent syndrome encountered by clinicians in their daily practice.[5] Although multimorbidity poses important challenges to clinical assessment and often leads to polypharmacy, patients with multimorbidity are often excluded from randomized controlled trials.[6–8] Cardiovascular and neuropsychiatric diseases are common chronic conditions in older adults with multimorbidity and affect both survival and disability-free survival.[9–14] Diseases belonging to the same clusters (eg, cardiovascular and neuropsychiatric diseases) share common risk factors and pathophysiological mechanisms, which lead to common preventive strategies and therapeutic choices. For example, angiotensin-converting enzyme inhibitors lower blood pressure, but also slow myocardial remodelling in heart failure and ischemic heart disease, and reduce the recurrence of atrial fibrillation. Given their class specificity, clinical relevance, and potential care implications, we focused, in the present study, on cardiovascular and neuropsychiatric multimorbidity. In the era of personalized medicine, identifying individual characteristics on which we may leverage with focused and effective interventions is of utmost importance.[9,15] However, when it comes to complex older adults, identifying groups of people—instead of single individuals—that may benefit from a given intervention is a more reasonable and accomplishable goal. In this regard, in line with the concept of deficit accumulation proposed to define the frailty syndrome, multimorbidity clusters, thought as indicators of the overall morbidity burden affecting a body system, may facilitate targeted interventions.[11,16–24]

Chronic diseases and functional impairment interact, boosting each other's deleterious effects.[25,26] However, the combined effect of multimorbidity and functional impairment on mortality is not well investigated. Walking speed is a reliable and easy-to-assess measure of functional status that is being more and more adopted in geriatric and non-geriatric clinical settings. As shown by several cohort studies, walking speed predicts survival in older people, independent of several chronic diseases. However, walking speed may be not only an indicator of disease severity, but also a good indicator of clinical and subclinical biological deficits across multiple organs and systems.[14,27–29]

We aimed to examine the effect of cardiovascular multimorbidity and functional impairment, along with the effect of neuropsychiatric multimorbidity and functional impairment, on all-cause and cause-specific mortality. We hypothesized that each pattern of diseases has a different prognostic effect and that the effect further varies by a person's functional status.

CLINICAL SIGNIFICANCE

- In older people, the prognosis of cardiovascular and neuropsychiatric diseases varies with the underlying functional status.
- Walking speed is an easy-to-perform test that provides additional prognostic information beyond the presence of multimorbidity.
- The assessment of both clinical and functional parameters may help to detect groups of people with similar care needs and prognosis.

METHODS

Study Design and Population

Data were derived from the Swedish National study of Aging and Care in Kungsholmen (SNAC-K), an ongoing study that includes older adults aged ≥60 years living in the community or in institutions in central Stockholm, Sweden.[30] People from 11 age cohorts were randomly invited to participate in the study. Of all eligible individuals, 3363 (participation rate 73%) were evaluated at baseline. Each participant undergoes a comprehensive evaluation lasting between 4 and 5 hours. Further details on the SNAC-K protocol have been previously published.[30] Due to missing baseline data on walking speed, 122 participants (3.6%) were excluded from the study leaving 3241. Participants with missing information on walking speed were older and more likely to live in a nursing home, and had more diseases and shorter survival than the participants ($P < .01$). The SNAC-K study was approved by the Regional Ethics Review Board in Stockholm. Participants, or their next of kin, provided written informed consent.

Chronic Diseases and Walking Speed

Physicians, nurses, and neuropsychologists performed extensive clinical and functional assessments of participants. Diagnoses were based on clinical examination, medical history, inpatient registers, medical charts, self-reported information, and proxy interviews. Clinical parameters, lab tests, and medications were used to diagnose specific conditions. Diagnoses were coded in accordance with the *International Classification of Diseases, 10th revision* (ICD-10) and classified in

Table 1 Baseline Sample Characteristics by Walking Speed

Characteristics	Walking Speed < 0.8 m/s n = 970 (30%)	Walking Speed ≥ 0.8 m/s n = 2271 (70%)	Total N = 3241
Demographics			
Female sex, n (%)	749 (77.2)	1337 (58.9)	2086 (64.4)
Age (years), mean ± SD	84.4 ± 8.8	70.0 ± 8.8	74.3 ± 11.0
Living in nursing home, n (%)	120 (12.3)	8 (0.4)	128 (4.0)
Education*			
Elementary, n (%)	294 (30.3)	261 (11.5)	555 (17.1)
High school, n (%)	495 (51.0)	1102 (48.5)	1597 (49.3)
University or higher, n (%)	159 (16.4)	908 (39.9)	1067 (32.9)
Clinical assessment†			
No. of diseases,‡ mean ± SD	5.7 ± 2.6	3.3 ± 2.0	4.0 ± 2.5
No. of medications, mean ± SD	5.8 ± 3.7	3.2 ± 2.9	4.0 ± 3.7
Malnutrition, n (%)	26 (5.8)	29 (1.3)	85 (2.6)
Mini-Mental State Examination score, mean ± SD	24.4 ± 7.4	28.9 ± 1.8	27.6 ± 4.8
Ischemic heart disease, n (%)	247 (25.5)	241 (10.6)	488 (15.1)
Heart failure, n (%)	238 (24.5)	87 (3.8)	325 (10.0)
Atrial fibrillation, n (%)	169 (17.4)	137 (6.0)	306 (9.4)
Depression and mood disorders, n (%)	125 (12.9)	161 (7.1)	286 (8.8)
Dementia, n (%)	230 (23.7)	19 (0.8)	249 (7.7)
Cerebrovascular disease, n (%)	148 (15.3)	90 (4.1)	239 (7.4)
Cardiovascular diseases,‡‖§ n (%)			
0	505 (52.1)	1860 (81.9)	2365 (73.0)
1	237 (24.4)	287 (12.6)	524 (16.2)
2+	228 (23.5)	124 (5.5)	352 (10.9)
Neuropsychiatric diseases,‡‖§ n (%)			
0	492 (50.7)	1872 (82.4)	2364 (72.9)
1	306 (31.6)	316 (13.9)	622 (19.2)
2+	172 (17.7)	83 (3.7)	255 (7.9)

SD = standard deviation.
*22 missing values for education.
† The 3 most prevalent cardiovascular and neuropsychiatric conditions are listed in this section.
‡ Out of 60 different chronic conditions as grouped by Calderon-Larranaga et al.[29]
§ The baseline distribution of all 7 cardiovascular and 12 neuropsychiatric diseases by walking speed is reported in Supplementary Table 2.
‖ The following cardiovascular and neuropsychiatric diseases have been considered: atrial fibrillation; bradycardias and conduction diseases; cardiac valve diseases; heart failure; ischemic heart disease; peripheral vascular disease; other cardiovascular diseases; cerebrovascular disease; dementia; depression and mood diseases; epilepsy; migraine and facial pain syndromes; multiple sclerosis; neurotic; stress related and somatoform diseases; Parkinson and parkinsonism; peripheral neuropathy; schizophrenia and delusional diseases; other neurological diseases; other psychiatric diseases.

homogeneous categories.[31] Seven cardiovascular and 12 neuropsychiatric chronic diseases were considered of interest in the present study (Table 1 and Supplementary Table 1, available online).[14]

Participants were asked to walk 6 m at their usual speed or 2.4 m, if the person reported walking slowly or the assessment was carried out in a restricted space. Speed was reported in m/s and categorized as <0.8 m/s or ≥ 0.8 m/s, as speeds of <0.8 m/s predict survival below the median in community-dwelling older adults.[27] Analyses were conducted separately for cardiovascular diseases and neuropsychiatric diseases. In each analysis, study participants were categorized in accordance with 6 clinical profiles, combining the presence of slow walking speed with the number of cardiovascular or neuropsychiatric diseases (0, 1, or ≥ 2).[14] The presence of cardiovascular diseases did not exclude the presence of neuropsychiatric diseases in the same person, and vice versa.

Vital Status

The main outcome of the study was all-cause mortality at 3 and 5 years. In a secondary analysis, we examined cardiovascular causes of mortality (ICD-10 I00-I79) and non-cardiovascular causes of mortality separately, to explore whether specific clinical profiles were selectively associated with fatal cardiovascular events. For this aim, only the underlying cause of death—and not the secondary causes of death—was considered. Dates and causes of death were derived from death certificates provided by Statistics Sweden, the Swedish national statistics agency.

Table 2 Association Between Clinical Patterns of Disease and 3-Year All-Cause Mortality by Walking Speed (≥0.8 vs <0.8 m/s)

	No. of Diseases	3-Year All-Cause Mortality			
		Deaths/People at Risk	IR per 100 person-years	Model 1* HR (95% CI)	Model 2† HR (95% CI)
Cardiovascular diseases					
WS ≥ 0.8 m/s	0	59/1860	1.1	1.00 (Ref.)	1.00 (Ref.)
	1	18/287	2.1	1.09 (0.64-1.87)	1.17 (0.68-2.01)
	2+	12/124	3.4	1.28 (0.68-2.41)	1.47 (0.78-2.80)
WS < 0.8 m/s	0	113/505	8.3	2.14 (1.50-3.05)	1.88 (1.29-2.74)
	1	98/237	17.3	3.95 (2.74-5.71)	3.85 (2.60-5.70)
	2+	111/228	21.8	4.57 (3.17-6.60)	5.18 (3.45-7.78)
Neuropsychiatric diseases					
WS ≥ 0.8 m/s	0	61/1872	1.1	1.00 (Ref.)	1.00 (Ref.)
	1	24/316	2.6	2.24 (1.39-3.59)	2.09 (1.30-3.37)
	2+	4/83	1.6	1.24 (0.44-3.41)	1.29 (0.47-3.55)
WS < 0.8 m/s	0	118/492	9.0	2.78 (1.99-3.90)	2.88 (2.03-4.08)
	1	129/306	17.8	4.68 (3.32-6.61)	3.36 (2.31-4.89)
	2+	75/172	18.6	5.76 (3.98-8.32)	3.68 (2.43-5.59)

CI = confidence interval; HR = hazard ratio; IR = incidence rate; WS = walking speed.
The reference group consisted of participants with preserved walking speed and no cardiovascular diseases or neuropsychiatric diseases.
*Model 1 was adjusted for age, sex, and education, and, if applicable, for number of neuropsychiatric diseases or cardiovascular diseases.
†Model 2 was adjusted for age, sex, education, number of medications, malnutrition, institutionalization, and Mini-Mental State Examination score, and, if applicable, for the number of neuropsychiatric diseases or cardiovascular diseases.

Covariates

Information on age, sex, education, and living arrangement was gathered by questionnaire. Malnutrition was defined as a body mass index <18.5 kg/m^2, as suggested by the European Society for Clinical Nutrition and Metabolism.[32] Medications used at the time of the assessment were coded using the Anatomical Therapeutic Chemical classification system. Global cognition was assessed with the Mini-Mental State Examination.

Statistical Analyses

We used Cox regression models to test the association between the clinical profiles that were created by combining walking speed and the number of cardiovascular diseases or neuropsychiatric diseases and 3- and 5-year all-cause mortality, adjusting for potential confounders (ie, age, sex, education, number of neuropsychiatric diseases, or cardiovascular diseases) and mediators (ie, number of medications, malnutrition, institutionalization, and Mini-Mental State Examination score). To address our research question (whether the underlying functional status modifies the prognosis of cardiovascular and neuropsychiatric diseases in older people) the reference group consisted of participants with preserved walking speed and no cardiovascular diseases or neuropsychiatric diseases. Both multiplicative and additive (relative excess risk due to interaction)[33,34] interactions between walking speed and cardiovascular and neuropsychiatric multimorbidity were tested. Fine-Gray competing risk regression models were used to assess the association between the clinical profiles and cause-specific (cardiovascular and non-cardiovascular) mortality. In a sensitivity analysis, in order to explore the impact of cardiovascular and neuropsychiatric multimorbidity on mortality among participants with reduced walking speed, the above described analyses were repeated taking participants with no cardiovascular or neuropsychiatric diseases and a slow walking speed as the reference group. In a second sensitivity analysis, we used a walking speed cut-off of <1 m/s. In addition, the association between the number of cardiovascular and neuropsychiatric diseases with mortality was tested in Cox regression models, adjusted and not for walking speed, considered as a continuous variable instead of an indicator variable. For these models, the Harrell's C-statistics was obtained. Finally, the predicted values for the hazards of mortality were plotted against walking speed as a continuous variable (with walking speed of 0.8 m/s as reference).

RESULTS

Table 1 shows the sample's characteristics at baseline by walking speed. After 3 years, 411 participants (12%) had died: 174 (5%) from cardiovascular causes and 237 (7%) from non-cardiovascular causes. After 5 years, overall 682 (21%) had died: 287 (9%) from cardiovascular causes and 395 (12%) from non-cardiovascular causes. Table 2 shows that after 3 years, compared with participants with preserved walking speed and without either cardiovascular or neuropsychiatric diseases, the multivariable-adjusted hazard ratios (HRs) (95% confidence interval) of all-cause mortality for people with functional impairment in combination with 0, 1, and ≥2 cardiovascular diseases were 1.88 (1.29-2.74),

3.85 (2.60-5.70), and 5.18 (3.45-7.78), respectively. The corresponding figures for people with 0, 1, and ≥2 neuropsychiatric diseases were 2.88 (2.03-4.08), 3.36 (2.31-4.89), and 3.68 (2.43-5.59), respectively. In participants with slow walking speed, results at 5 years were consistent, but the presence of 1 and 2 or more cardiovascular diseases was also associated with mortality in participants with preserved walking speed (Supplementary Table 3, available online). In a similar analysis of neuropsychiatric diseases (Table 2), an increasing number of diseases were associated with higher 3-year mortality in those with slow walking speed, compared with those with preserved walking speed and zero neuropsychiatric diseases. Considering only people with ≥2 cardiovascular diseases or ≥2 neuropsychiatric diseases, those with slow walking speed had a crude excess risk for 3-year mortality of 18.4/100 person-years, and 17/100 person-years, respectively, than those with preserved walking speed. The results of the 5-year follow up were consistent with those of the 3-year follow-up, although mildly attenuated (Supplementary Table 3, available online). No multiplicative interaction emerged between cardiovascular or neuropsychiatric multimorbidity and walking speed. However, an additive interaction was demonstrated: 42% (6.3 deaths per 100 person-years; $P < .001$) and 34% (5.2 deaths per 100 person-years; $P = .012$) of the relative excess risk of all-cause mortality at 3 years, observed in participants with multimorbidity (cardiovascular and neuropsychiatric, respectively) and slow walking speed, was due to the combined effect of slow walking speed and cardiovascular and neuropsychiatric multimorbidity, respectively.

Figure 1 depicts the estimated HRs of 3-year all-cause mortality for different walking speeds in the overall study sample and in participants with 0, 1, or ≥2 cardiovascular diseases or neuropsychiatric diseases (reference speed: 0.8 m/s). Participants who walked <0.8 m/s had an increased mortality (Figure 1, dashed line). Hazards increased further in the presence of 1 or more cardiovascular disease or neuropsychiatric diseases. Participants with ≥2 neuropsychiatric diseases did not have a higher hazard for mortality than participants with 1 neuropsychiatric disease. Results were similar at 5 years (Supplementary Figure 1, available online).

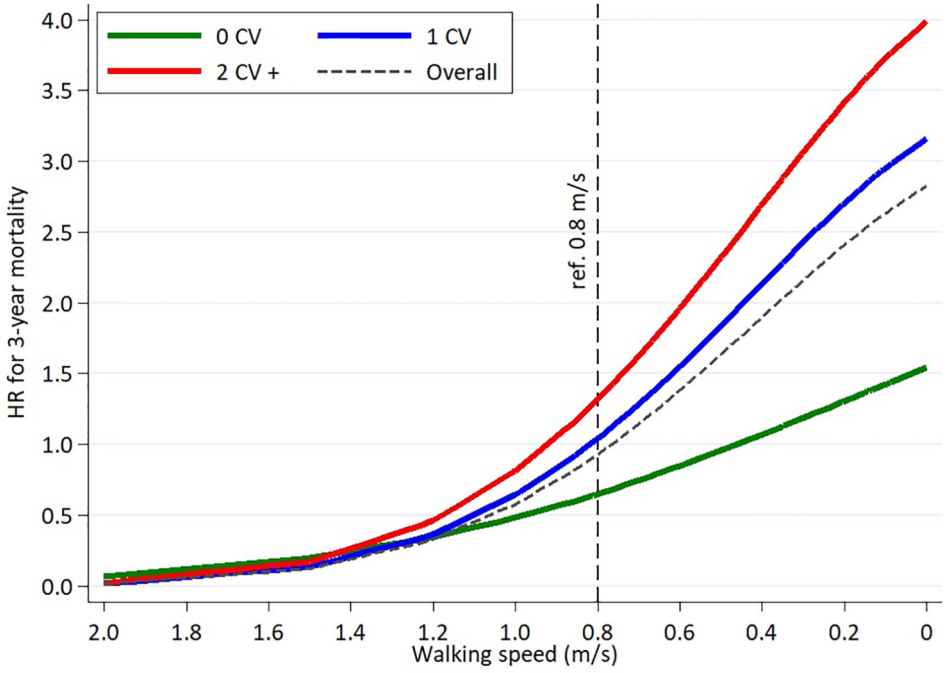
When we looked solely at people who died of cardiovascular diseases, an increasing burden of cardiovascular diseases was associated with an increasing hazard for 3-year mortality in participants with and without slow walking speed (Table 3). When we looked solely at non-cardiovascular mortality, an increasing burden of cardiovascular diseases was associated with increasing mortality only in those with slow walking speed. These findings were similar at 5 years (Supplementary Table 4, available online). The pattern was similar in neuropsychiatric diseases and at both 3 and 5 years (Table 3 and Supplementary Table 4, available online).

When participants without cardiovascular or neuropsychiatric diseases and slow walking speed were considered as the reference group, an increasing number of cardiovascular diseases—but not neuropsychiatric diseases—were associated with higher mortality. This was confirmed for both 3- and 5-year follow-ups, and for both cardiovascular and non-cardiovascular mortality. When using a cut-off of <1 m/s to define slow walking speed, the direction and strength of the associations remained similar. In a last sensitivity analysis, the number of cardiovascular diseases was associated with 3-year mortality when not adjusting for walking speed (HRs for 1 and ≥2 cardiovascular diseases were 1.77 and 2.28, respectively; $P < .001$ for both; C-statistics = 0.843) and when adjusting for walking speed (HRs for 1 and ≥2 cardiovascular diseases were 1.70 and 2.22, respectively; $P < .001$ for both; C-statistics = 0.861). Similarly, the number of neuropsychiatric diseases was associated with 3-year mortality when not adjusting for walking speed (HRs for 1 and ≥2 neuropsychiatric diseases were 2.10 and 2.61, respectively; $P < .001$ for both; C-statistics = 0.844) and when adjusting for walking speed (HRs for 1 and 2 ≥ neuropsychiatric diseases were 1.59 and 1.72, respectively; $P < .001$ for both; C-statistics = 0.861). Similar findings were obtained for 5-year mortality.

DISCUSSION

We found that in older people walking speed provides additional prognostic information in terms of mortality, beyond the number of cardiovascular and neuropsychiatric diseases, independently of potential confounders. In participants with slow walking speed, the association with mortality (especially cardiovascular mortality) was stronger for cardiovascular diseases. These findings represent elements of novelty in the field. This is the first study to find that a simple marker of functional status such as walking speed predicts mortality in older adults who have specific groups of chronic diseases. Moreover, our findings support the existence of interplay between cardiovascular or neuropsychiatric diseases and walking speed, and suggest that walking speed could be a reliable prognostic tool, easy to use in clinical practice.

Several previous studies have shown significant associations between multimorbidity and mortality. Notably, a multiplicative interaction among cardiometabolic diseases has been found, suggesting that when combined, these diseases exert a negative impact on survival beyond the sum of their individual effects.[6] The prognosis of people with several risk factors (eg, hypertension) and chronic diseases, and following invasive procedures (eg, heart surgery) may vary depending on the person's functional status.[25,26,35–38] Functional status may mediate the association of multimorbidity with mortality;[39,40] however, there are no studies investigating how interplay between functional impairment and specific groups of chronic diseases changes people's prognosis. The differential impact of different groups of chronic diseases on other health outcomes, such as functional decline, has been previously demonstrated.[41–43] Our group has shown that clinical patterns including multiple cardiovascular and neuropsychiatric diseases were associated with the steepest functional decline. We also have shown that neuropsychiatric diseases, alone or in combination, were the major determinants of functional decline, and that isolated



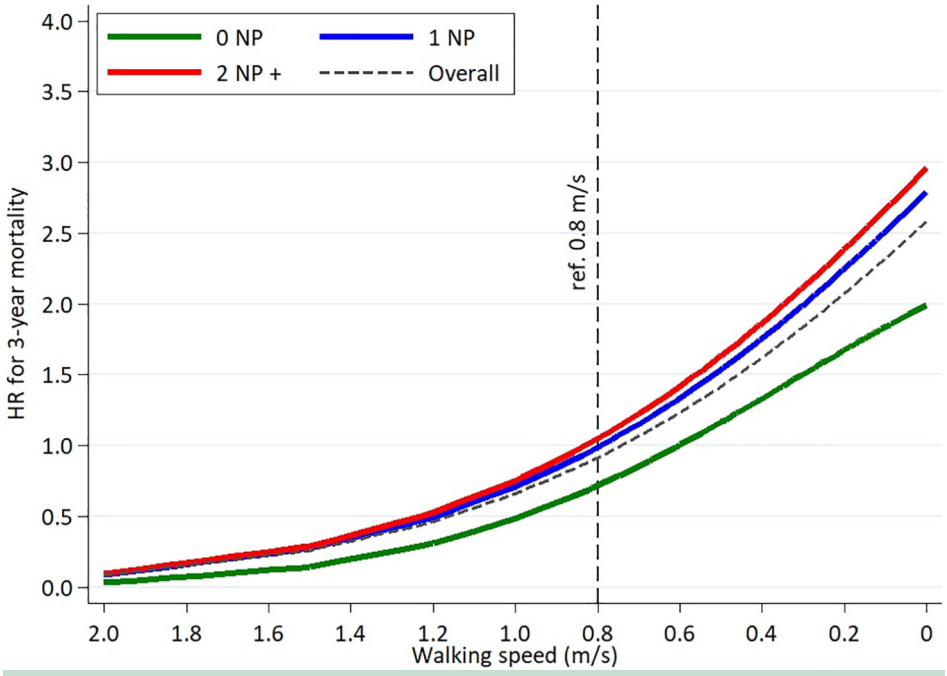


Figure 1 Estimated hazard ratio (HRs) of 3-year all-cause mortality for different values of walking speed (reference 0.8 m/s) in the overall population (centering the number of diseases on their average number) and in participants with 0, 1, or 2+ cardiovascular and neuropsychiatric diseases. Cox regression models adjusted for age, sex, education, number of NP diseases or CV diseases, number of medications, malnutrition, institutionalization, and Mini-Mental State Examination score.

cardiovascular multimorbidity only impacted walking speed.[14] In the present study, we moved a step forward, and showed that the prognosis of the same group of chronic diseases (ie, cardiovascular and neuropsychiatric) changes depending on the underlying functional status.

Many factors can influence walking speed, and this needs to be taken into consideration in the interpretation of our results. First, slow walking speed may derive from acute or chronic systemic conditions (eg, fever or malnutrition). Second, the impairment of a single organ (eg, hip osteoarthritis) may directly or indirectly (eg heart failure) slow walking speed. Mental conditions such as depression, which affect vitality, may impact walking speed. Third, slow walking speed may be a symptom of a specific disease (eg, Parkinson disease). All these potential causes, even when only present at the subclinical level may interact, which makes walking

Table 3 Association Between Walking Speed by Clinical Patterns of Disease and 3-Year Cause-Specific (CV and non-CV) Mortality*

	No. of Diseases	3-Year Cardiovascular Mortality			3-Year Non-Cardiovascular Mortality		
		Deaths/ People at Risk	IR per 100 Person-Years	sHR (95% CI)	Deaths/ People at Risk	IR per 100 Person-Years	sHR (95% CI)
Cardiovascular diseases							
WS ≥ 0.8 m/s	0	17/1860	0.3	1.00 (Ref.)	42/1860	0.8	1.00 (Ref.)
	1	9/287	1.1	2.10 (0.89-4.93)	9/287	1.1	0.88 (0.43-1.82)
	2+	8/124	2.2	3.47 (1.37-8.80)	4/124	1.1	0.75 (0.30-2.11)
WS < 0.8 m/s	0	42/505	3.1	2.56 (1.31-5.02)	71/505	5.2	1.96 (1.21-3.17)
	1	45/237	7.9	5.36 (2.69-10.70)	53/237	9.3	3.11 (1.81-5.36)
	2+	53/228	10.4	6.86 (3.31-14.23)	58/228	11.4	3.82 (2.20-6.63)
Neuropsychiatric diseases							
WS ≥ 0.8 m/s	0	19/1872	0.3	1.00 (Ref.)	42/1872	0.8	1.00 (Ref.)
	1	14/316	1.5	4.15 (2.12-8.13)	10/316	1.1	1.18 (0.59-2.38)
	2+	1/83	0.4	0.99 (0.13-7.55)	3/83	1.2	1.55 (0.48-5.00)
WS < 0.8 m/s	0	57/492	4.3	3.70 (2.10-6.50)	61/492	4.6	2.62 (1.62-4.23)
	1	50/306	6.9	3.58 (1.89-6.78)	79/306	10.9	3.08 (1.85-5.13)
	2+	33/172	8.2	5.11 (2.60-10.04)	42/172	10.4	2.80 (1.56-5.06)

CI = confidence interval; IR = incidence rate; sHR = sub-distributional hazard ratio; WS = walking speed.
*Models were adjusted for age, sex, education, number of medications, malnutrition, institutionalization, and Mini-Mental State Examination score, and, if applicable, for the number of neuropsychiatric diseases or cardiovascular diseases.
The reference group consisted of participants with preserved walking speed and no cardiovascular diseases or neuropsychiatric diseases.

speed a comprehensive vital parameter.[14,27,28,44] In such cases, there is a certain overlap between disease and physical functioning, which may be interpreted as an indicator of severity. In older adults, untangling the roles played by each of these potential determinants proves challenging. Notably, in line with our findings, a previous study has shown that slow walking speed is more strongly associated with mortality due to cardiovascular diseases than to other causes.[45]

This study had several strengths. First, diseases were diagnosed using a comprehensive and accurate method previously validated in SNAC-K. Second, SNAC-K has a relatively high participation rate (73%) and includes people who live in institutions, both of which increase the generalizability of our results. Some limitations need to be mentioned. First, we did not take into consideration the severity of specific diseases, which could play a major role in the association between multimorbidity and mortality. However, beyond combining the number of cardiovascular and neuropsychiatric diseases with the presence of slow walking speed (partly influenced by disease severity) we adjusted our analyses for several factors that are indicators of the severity of diseases (eg, number of medications). Moreover, in this study we did not investigate the differential impact of individual cardiovascular and neuropsychiatric conditions. Still, as demonstrated in previous studies from our and other groups, homogenous patterns of multimorbidity convey an overall group-specific effect, independent of single conditions, with respect to several outcomes.[6,14] Second, both the clinical and functional status of participants may have changed during follow-up, which could have affected the strength of the association between the disease groups and mortality. Change in status may help explain the observed attenuation of the association between the 3- and 5-year follow-up. Finally, the SNAC-K population is fairly fit and relatively wealthy, which may further limit the generalizability of our results.

In conclusion, our study suggests that slow walking speed, an indicator of functional impairment, provides additional prognostic information in terms of mortality, beyond the number of cardiovascular and neuropsychiatric diseases, independently of potential confounders, and particularly in the short-term period. The adoption of a simple and easy-to-use measure of functional impairment such as walking speed may help healthcare professionals in identifying older people affected by specific groups of chronic diseases that have similar needs, health trajectories, and prognoses. In agreement with recent guidelines on multimorbidity, our findings support the simultaneous assessment of clinical and functional parameters that facilitates the identification of patients' clinical priorities, of optimal drug treatment, and better counseling.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjmed.2019.05.005.