

# Do Performance-based Health Measures Reflect Differences in Frailty Among Immigrants Age 50+ in Europe?



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## ABSTRACT

### Background

Life course influences, including country of residence and country of birth, are associated with frailty index scores. We investigated these associations using performance-based health measures.

### Methods

Among 33,745 participants age 50+ (mean age 64.8 ± 10.1; 55% women) in the Survey of Health, Ageing, and Retirement in Europe, grip strength, delayed word recall, and semantic verbal fluency were assessed. Participants were grouped by country of residence (Northern/Western Europe or Southern/Eastern Europe), and by country of birth (native-born, immigrants born in low- and middle-income countries [LMICs], or immigrants born in high-income countries [HICs]).

### Results

Participants in Southern/Eastern Europe had lower mean test scores than those in Northern/Western Europe, and their scores did not differ by country of birth group. In Northern/Western Europe, compared with native-born participants, LMIC-born immigrants demonstrated lower mean grip strength (32.8 ± 7.6 kg vs. 35.7 ± 7.7 kg), delayed recall (2.9 ± 1.9 vs. 3.6 ± 1.9), and verbal fluency scores (16.0 ± 6.9 vs. 20.3 ± 7.0). HIC-born immigrants had mean scores higher than LMIC-born immigrants, but lower than native-born participants (all  $p < .001$ ).

### Conclusions

Cognitive and motor performance, measured from late middle age, were associated with national income levels of both

country of residence and country of birth. This was similar to previously observed differences in frailty index scores.

**Key words:** aging, migration, grip, recall, cognition, frailty, epidemiologic determinants

## INTRODUCTION

Health at older ages is influenced by multiple extrinsic factors across the life course, including environmental wealth and resources.<sup>(1-3)</sup> With global populations ageing, it is increasingly important to identify how such differences in health arise across the life course and, ultimately, how they might be ameliorated.<sup>(3-6)</sup> Cross-sectional data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) show that, compared with middle-aged and older adults living in wealthier Northern and Western European countries, people living in less wealthy Southern and Eastern European countries exhibit higher levels of frailty.<sup>(2,7)</sup> Early life environment might also have a lasting effect. Further SHARE data show that, in Northern and Western Europe, immigrants who were born in low- and middle-income countries (LMICs) experience higher levels of frailty than either native-born Europeans or immigrants who were born in high-income countries (HICs).<sup>(8)</sup> This disparity was not present in Southern and Eastern Europe, where each group has similarly high levels of frailty.<sup>(8)</sup>

In these previous SHARE reports, health status was assessed using frailty scales comprised primarily of self-reported data.<sup>(2,7,8)</sup> Because participants were grouped according to regional and cultural backgrounds, it is possible that differences identified by these self-reported measures instead reflect differences in participants' perception and reporting of health and illness.<sup>(9)</sup> In the present study, using SHARE data, we evaluated whether the performance-based measures identify the same health disparities previously identified with frailty scales, according to national income

levels of both participants' country of residence and country of birth.

## METHODS

The setting and sample for this study have been described in detail elsewhere.<sup>(8)</sup> Briefly, this is a secondary analysis of participants' baseline data from the first (2004/2005) and second (2006/2007) waves of the Survey of Health, Ageing and Retirement in Europe (SHARE; release 2.5.0 of May 24th 2011). SHARE includes probability samples of community-dwelling people age 50 and older and their spouses of all ages in 15 European countries (first wave: Austria, Belgium, Denmark, France, Germany, Greece, Israel, Italy, Netherlands, Spain, Sweden, Switzerland; second wave: Czech Republic, Poland, Ireland). In the present study, we excluded participants under the age of 50, as well as all participants living in Israel, as the immigration characteristics of the Israeli cohort were substantially different from the other countries (e.g., 50% of Israeli participants report being born outside of Israel). The sample considered here included 33,745 participants (mean age  $64.8 \pm 10.1$ ; 55% women). Mortality data were obtained from the second (2006/2007), third (2008/2009), and fourth (2010/2011) waves of SHARE

Participants were grouped by current country of residence according to United Nations-defined regions into wealthier Northern/Western Europe (Austria, Belgium, Denmark, France, Germany, Ireland, Netherlands, Sweden, Switzerland) and less-wealthy Southern/Eastern Europe (Czech Republic, Greece, Italy, Poland, Spain).<sup>(2,10)</sup> Participants who reported being born outside their current country of residence were identified as immigrants. Immigrants were grouped by their country of birth, according to 2007 World Bank classification, as those born in low- and middle-income countries (LMICs) or in high-income countries (HICs).<sup>(8,11)</sup> As described previously, 3.4% of participants ( $n = 1,157$ ) were immigrants born in LMICs and 3.6% of participants ( $n = 1,212$ ) were immigrants born in HICs.<sup>(8)</sup> LMIC-born immigrants more often lived in Southern/Eastern Europe than HIC-born immigrants. Native-born participants were older than LMIC-born immigrants, but not HIC-born immigrants.<sup>(8)</sup>

## Health Measures

Performance-based health measures were one test of physical function<sup>(12)</sup> and two tests of cognitive performance.<sup>(13)</sup> Grip strength was assessed as the maximum score out of four trials (two on each hand), recorded with a dynamometer. In a delayed word recall test, participants were asked to immediately repeat a 10-word list of nouns aloud, and then asked to recall this list a few minutes later after answering other questions. A semantic verbal fluency test asked participants to name as many animals as possible in one minute.

As previously described, the frailty index used in this study was comprised of 70 health measures from the

physical health, health behaviours, cognitive function, and mental health sections of the SHARE survey.<sup>(2)</sup> Each measure was mapped to a 0–1 interval, where a value of 0 was assigned in a given measure when a health deficit was absent, and a value of 1 was assigned when a health deficit was present.<sup>(14)</sup> Each participant's frailty index score was calculated as the proportion of deficits present out of the 70 health measures.<sup>(2,14)</sup>

## Statistical Analysis

We first evaluated the missingness of performance-based measure values. As failure to complete performance-based health measures is associated with worse outcomes,<sup>(15,16)</sup> we compared frailty index scores and five-year mortality between those with missing and with non-missing values for performance-based tests using analyses of variance (ANOVA) and Mann-Whitney U tests, respectively. Correlations were calculated between performance-based tests and frailty index scores. Test scores were compared between residents of Northern/Western Europe and Southern/Eastern Europe, and also between LMIC-born immigrants, HIC-born immigrants, and native-born participants separately in the two regions, using analyses of covariance (ANCOVA) techniques adjusted differences in age (years), gender, and education level (United Nations ISCED-97 code).<sup>(8)</sup> Analyses were performed with PASW Statistics (18.0.0). Secondary analyses were approved by the Research Ethics Committee of Capital District Health Authority, Halifax, Nova Scotia, Canada.

## RESULTS

Grip strength measurements were available for 30,947 (91.7%) participants, delayed recall test scores for 33,268 (98.6%) participants, and verbal fluency test scores for 33,261 (98%) participants. In Southern/Eastern Europe, missingness of all three outcome variables was similar across country of birth groups. In Northern/Western Europe, missingness of all three outcome variables was lowest among native-born participants and highest among LMIC-born immigrants (grip strength ranged from 7.7% to 13.5%; delayed recall ranged from 1.4% to 3.2%; verbal fluency ranged from 1.9% to 5.2%). For all three tests, participants who were missing data had higher frailty index scores and higher five-year mortality rates than participants who were not missing data (Table 1). This was consistent across all country of residence and country of birth groups; however, statistical analyses of the relationship between missingness, frailty, and mortality were not conducted for subgroups due to small sample sizes.

Correlation coefficients between the 70-item frailty index and the performance-based measures were -0.43 for grip strength, -0.38 for delayed recall, and -0.36 for verbal fluency (all  $p < .001$ ). Correlation coefficient values between frailty index scores and performance-based tests were similar in country of residence and country of birth subgroups.

TABLE 1.

Mean frailty index scores and five-year mortality rate for participants with non-missing data and with missing data on performance-based health measures.

Test	Sample Size (% of participants)		Frailty Index Score (mean ± SD)		Five-year Mortality Rate (%)	
	Participants with non-missing values	Participants with missing values	Participants with non-missing values	Participants with missing values	Participants with non-missing values	Participants with missing values
Grip strength	30,915 (91.7)	2,795 (8.3)	0.15 ± 0.11	0.28 ± 0.19	10.2	34.9
Delayed recall	33,234 (98.6)	476 (1.4)	0.16 ± 0.12	0.31 ± 0.21	11.3	60.9
Verbal fluency	33,049 (98.0)	661 (2.0)	0.16 ± 0.12	0.32 ± 0.21	11.1	54.8

SD = Standard Deviation.

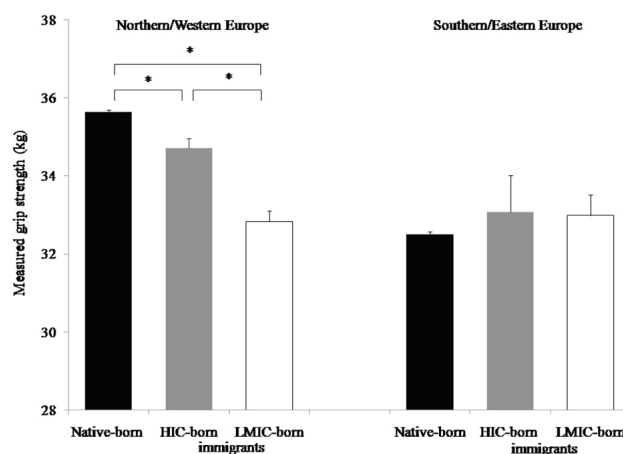
Grip strength values ranged from 1 kg to 92 kg (mean 34.4 ± 12.3 kg). Mean grip strength, adjusted for age, gender, and education, was higher in Northern/Western Europe (35.3 ± 7.9 kg) than in Southern/Eastern Europe (32.9 ± 7.8 kg; *p* < .001). In Northern/Western Europe, test scores differed by country of birth group, with immigrants having lower adjusted mean grip strength than native-born participants. LMIC-born immigrants had lower grip strength than HIC-born immigrants and native-born participants, and HIC-born immigrants had lower grip strength than native-born participants (Figure 1). In Southern/Eastern Europe, there were no significant differences between country of birth groups (Figure 1).

Delayed recall test scores ranged from 0 to 10 words (mean 3.3 ± 2.0 words). Adjusted mean delayed recall score was higher in Northern/Western Europe (3.5 ± 1.9) than Southern/Eastern Europe (2.9 ± 1.8; *p* < .001). In Northern/Western Europe, LMIC-born immigrants had lower adjusted delayed recall scores than HIC-born immigrants and native-born participants, and HIC-born immigrants had lower scores than native-born participants (Figure 2). In Southern/Eastern Europe, there were no significant differences in scores between country of birth groups (Figure 2).

Verbal fluency test scores ranged from zero to 100 (mean 18.3 ± 5.9). Adjusted mean verbal fluency test scores were higher in Northern/Western Europe (19.8 ± 6.7) than Southern/Eastern Europe (15.8 ± 6.7; *p* < .001). In Northern/Western Europe, LMIC-born immigrants had lower verbal fluency test scores than HIC-born immigrants and native-born participants, and HIC-born immigrants had lower scores than native-born participants (Figure 3). In Southern/Eastern Europe, there were no significant differences between country of birth groups (Figure 3).

## DISCUSSION

In a large sample of community-dwelling Europeans in 14 countries, we found that grip strength and cognitive performance differed with national income levels in both current country of residence and country of birth. Participants currently living in wealthier Northern/Western Europe had

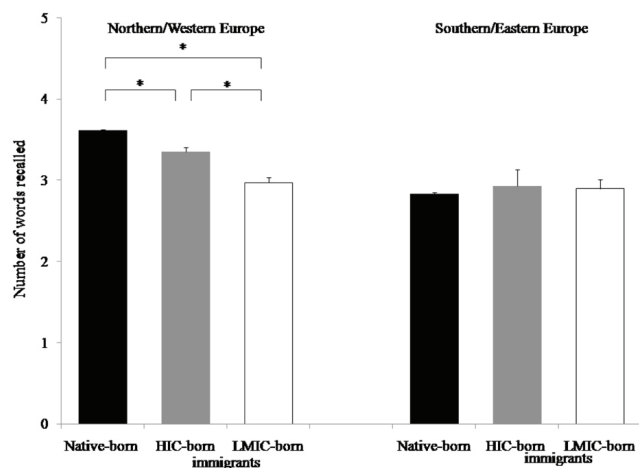


\**p* < .001.

FIGURE 1. Mean grip strength among participants grouped by country of residence and country of birth, adjusted for age, gender, and education. Vertical bars represent standard error

higher scores on all tests than did those living in Southern/Eastern Europe. In Northern/Western Europe, immigrants born in low- or middle-income countries (LMICs) had lower scores than both immigrants born in high-income countries (HICs) and native-born participants. Even so, HIC-born immigrants had lower scores than native-born participants. In Southern/Eastern Europe, such disparities between country of birth groups were not apparent. While performance-based measures were negatively correlated with a 70-item frailty index, participants with missing data for performance-based measures had higher levels of frailty and higher mortality rates than participants with non-missing data.

Our results should be interpreted with caution. SHARE was not designed to be representative of European migrants, and so likely excludes more vulnerable migrants (e.g., undocumented migrants and seasonal workers) from the sampling frame. However, as our data show migrants had worse age-related health, it is unlikely that this selection bias influenced the direction of the observed relationship. Further, the groups of migrants in our study (here



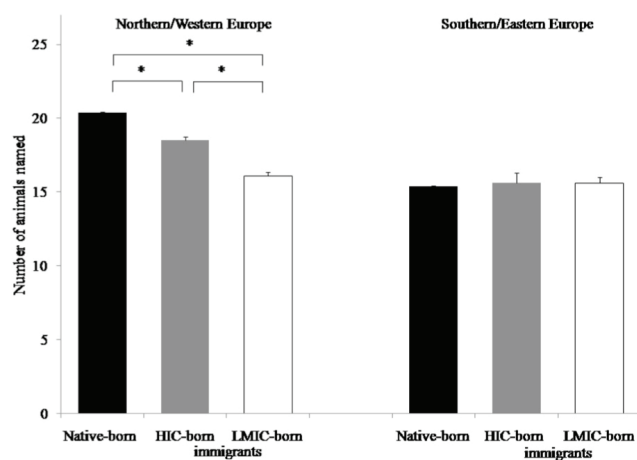
\* $p < .001$ .

FIGURE 2. Mean delayed recall scores among participants grouped by country of residence and country of birth, adjusted for age, gender, and education. Vertical bars represent standard error

dichotomized as those born in high-income or in low- and middle-income countries) comprise people with extremely diverse migration, health, and socioeconomic life course experiences. Immigrants were grouped as such in this study and in previous studies<sup>(8)</sup> because low- and middle-income countries, as categorized by the World Bank, are commonly referred to as “developing” countries. Further work is needed to assess the individual contributions of more specific experiences to later life health, but it was notable that even these broad groupings characterized consistent, observable patterns across multiple health measures.

Our results, showing weaker grip strength and lower cognitive performance scores among participants currently living in relatively poorer European countries and among participants who were born in low- and middle-income countries, support prior studies. A previous report from SHARE identified that grip strength was inversely related to education and wealth.<sup>(12)</sup> Multiple studies have identified that adverse socioeconomic circumstances early in life are independently associated with weak grip strength in middle-age,<sup>(17,18)</sup> but more recent socioeconomic circumstances appear to be more important.<sup>(18)</sup> Cognitive impairment has also been associated with adverse social and environmental factors across the life course, including among international migrants who were born in lower income countries.<sup>(19)</sup> Finally, positive correlations have repeatedly been identified between muscle strength and cognitive ability in older adults.<sup>(20-23)</sup> Taken together, the data suggest that early life factors have influences that stretch across the life course, including ones associated with late life frailty.<sup>(8)</sup> Similarly, they are consistent with observations that the deficit accumulation that defines frailty can be observed across the life course.<sup>(24)</sup>

Overall our data suggest that place of residence and place of birth might influence age-related health. This was



\* $p < .001$

FIGURE 3. Mean verbal fluency scores among participants grouped by country of residence and country of birth, adjusted for age, gender, and education. Vertical bars represent standard error

identified in a prior study using a 70-item frailty index comprised primarily of self-reported data<sup>(8)</sup> and in this study using performance-based measures of grip strength and cognition. This further suggests that frailty indices integrating multiple measures of self-reported data could be appropriate to use among participants of different nationalities and cultural backgrounds. The question of appropriate cross-population frailty measurement continues to motivate inquiry by our group.

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## CONFLICT OF INTEREST DISCLOSURES

With colleagues, KR has applied for funding to commercialize a version of the frailty index based on a comprehensive geriatric assessment. A company called Videx Canada has been incorporated for this. The version of the frailty index presented here is not the one that Videx aims to commercialize. TB and OT report no conflicts of interest.

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