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Associations of Anemia and Physical Function in Georgia Centenarians

Alyson Haslam, MS[1], **Dorothy B. Hausman, PhD**[1], **Adam Davey, PhD**[2], **M. Elaine Cress, PhD**[3], **Mary Ann Johnson, PhD**[1], and **Leonard W. Poon, PhD**[3] **for the Georgia Centenarian Study**

[1]Department of Foods and Nutrition, University of Georgia, Athens, GA

[2]Department of Public Health, Temple University, Philadelphia, PA

[3]Institute of Gerontology, University of Georgia, Athens, GA

To the Editor: Anemia is a common condition among older adults, affecting up to 50% of centenarians.[1] Physical function limitations are also common among older individuals, affecting 42% of those 65 years and older, and are more likely to occur with advancing age.[2] Functional status is often measured by how well an individual can complete activities common to daily life, which reflects muscular strength and mobility. Studies have shown an association between anemia and both physical function and strength.[3-6] However, most studies of anemia and physical function have focused on older adults collectively, and have not made distinctions between those who are in their sixties and seventies and those in their nineties and one-hundreds. Thus, the question remains as to whether or not the association between anemia and physical function holds true in the very old. Considering the high prevalence of anemia and disability among the very old and the association between these two conditions, a better understanding of this association could help in characterizing the potential disability in the very old, as well as encouraging the assessment and treatment of preventable forms of anemia in order to increase performance and promote independence.

Therefore, we recently conducted a secondary analysis of data from the Georgia Centenarian Study (GCS)[7], to examine differences between levels of physical function, among centenarians, with and without anemia. The study, approved by the University of Georgia institutional review board on human subjects was a population-based sampling that including 244 centenarians and near centenarians (98+ years) from Georgia, USA. More thorough details of recruitment, sampling procedures, and participant characteristics have been described elsewhere.[1,7]

For the present analysis, anemia was defined as hemoglobin <13 g/dl for males and <12 g/dl for females[1]. Measures of physical function and strength included average grip strength, knee extensor strength, activities of daily living (basic and instrumental), Short Physical Performance Battery, and GCS composite score.[8] Chi-Square and Wilcoxon-Rank Sum analysis were used to determine differences in descriptive characteristics between centenarians with and without anemia. Multivariable regression analysis was performed for each measure of strength and physical function and excluded only those missing data for

Corresponding author: Dorothy B. Hausman, Ph.D. The University of Georgia Department of Foods and Nutrition 280 Dawson Hall Athens, GA 30602 USA Phone: 706-542-4871 FAX: 706-542-5059 dhausman@uga.edu.

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covariates and the dependent physical function variable for each individual analysis. Covariates included body mass index, Mini Mental State Examination score, estimated creatinine clearance, and sum of chronic disease present at time of interview (osteoporosis, chronic kidney disease, diabetes, chronic airway obstruction, cancer, hypertension, Parkinson's, and peripheral vascular disease).

The average age of the participants was 100.5 years, and similar for those with and without anemia (Table 1). Eighty-three percent of the study participants were female, 81.1% were white, and 41.9% lived in a skilled nursing facility. The prevalence of anemia was greater in males than females (66.6% vs. 48.6%, $p < 0.05$) and tended to be greater in African Americans than in white participants (63.4% vs. 48.8%, $p = 0.09$), but did not differ by residence. Bivariate analysis indicated that centenarians with anemia had 3.5 kg (approximately 27%) lower average hand grip strength than those without anemia. In partially (demographics; Table 1) and fully adjusted (demographics and disease states; data not shown) multiple regression models, centenarians with anemia were found to have both lower grip strength and leg strength than centenarians without anemia. Anemia was not associated with lower scores on other measures of physical function in either bivariate or multiple regression analyses. The lack of association between anemia and other measures of physical function, requiring multiplicity of function, may be partly explained by chronic disease, specifically chronic kidney disease. Den Elzen et al. found that among those 85+ years, there were no differences in physical function ability between those with anemia and those without, when controlled for inflammatory markers and creatinine clearance.[3] Previously, decreased kidney function was found to be a predictor of anemia in GCS participants.[1]

In conclusion, anemia in this population-based sampling of centenarians is associated with lower hand-grip and leg strength, but not physical function in everyday activities. These observations support the findings of Penninx et al.[5] who also found associations of anemia with grip strength and leg strength, but in a "younger" older adult population. Maintenance of muscle strength is especially important for older people, as poor grip strength has been identified as a predictor of future disability.[9] The robust association of anemia with hand grip strength suggests that treating anemia, when possible, may be important for preserving strength in the very old, thus potentially minimizing the decline in physical function and disability.

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Table 1

Measures of Physical Function in Georgia Centenarians with and without Anemia and Results of a Series of Linear Regression Analyses Examining Associations Between Measures of Physical Function or Strength (Dependent Variable) and Anemia Status (Independent Variable)[ab]

	Anemia Status			Partially Adjusted Model[c]	
Characteristic, mean (± SD)	**Anemic**	**Non-anemic**	***P-value***	**Difference (95%CI)**	***P-value***
Age (years)	100.1 (± 1.7)	100.7 (± 2.0)	0.191	_	_
Hemoglobin (g/dl)	10.9 (± 1.0)	13.2 (± 0.9)	<0.0001	_	_
Grip strength, average (kg) (n=216)	9.3 (± 8.7)	12.8 (± 12.3)	0.040	−3.7 (−6.1 to −1.2)	0.003
Leg strength, average (kg) (n=142)	7.5 (± 5.0)	8.9 (± 6.1)	0.112	−1.8 (−3.6 to −0.1)	0.037
Directly assessed functional status, basic activities of daily living (DAFS BADL; n=204)	17.1 (± 7.5) [d]	17.5 (± 7.6)	0.407	0.40 (−1.5 to 2.3)	0.685
Directly assessed functional status, instrumental activities of daily living (DAFS IADL; n=204)	27.3 (± 18.4)	27.6 (± 17.9)	0.901	1.5 (−2.8 to 5.9)	0.491
Short Physical Performance Battery (SPPB; n=211)	1.45 (± 2.2)	1.7 (± 2.4)	0.532	−0.04 (−0.6 to 0.5)	0.898
Georgia Centenarian Study Composite Scale[f] (GCS; n=217)	5.2 (± 3.0)	5.8 (± 3.0)	0.164	−0.4 (−1.0 to 0.3)	0.284

[a] Individuals missing information for the dependent variable were excluded from the pertinent analyses.

[b] Anemia defined as hemoglobin <12 g/d for females and <13 g/dl for males

[c] Adjusted for demographics (sex, race, and living arrangements).

[d] Possible range of scores for functional tests: DAFS BADL, 0-23; DAFS IADL, 0-58; SPPB, 0-12; GCS Composite, 0-12.

SD = standard deviation.