Association between Anemia and Hemoglobin Level with Health Status Index (HSI) and Activities of Daily Living (ADL) for Long Term Care(LTC) Residents in Colorado

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BACKGROUND

- Anemia is common in LTC residents with prevalence estimates ranging from 47% to 56% across four studies[1-4]
- Previous studies in community dwelling adults have reported that anemia is associated with:[5-8]
  - Reduced quality of life
  - Impaired physical functioning
  - Increased risk of falls
  - Increased risk of dementia and depression
  - Increased morbidity and mortality
- Recent reports that have included LTC residents in the study population suggest that anemia may be associated with:
  - Increased risk for falls[8-10]
  - Increased risk of hospital admissions[11]
- There is currently limited information related to anemia and its potential impact on physical functional status or health related quality of life (HRQOL) in LTC residents

HEALTH-RELATED QUALITY OF LIFE (HRQOL)/HEALTH STATUS INDEX (HSI)

- HRQOL and health status are important outcomes in geriatric care
- Little is known about the association between anemia and HRQOL in the nursing home
- To assess HRQOL in LTC residents, Wodchis developed and validated a tool to map key elements of the MDS to the Health Utilities Index Mark 2 (HUI2) instrument[12]
- The resulting tool, the Minimum Data Set Health Status Index (MDS-HSI):[12]
  - Summarizes the 6 HRQOL attributes of sensation, mobility, emotion, cognition, self-care, and pain that are included in the HUI2
  - Has been validated as a tool for assessment of HRQOL in LTC residents

FUNCTIONAL IMPAIRMENTS/ACTIVITIES OF DAILY LIVING (ADL)

- Maintenance of functional status is an important goal in the care of geriatric patients[13]
- Anemia has been associated with functional impairment in community dwelling older adults [8,14-17]
- The ADL self performance ratings section G of the MDS version 2.0 have been used to evaluate physical functioning in the nursing home[8,18]
- Carpenter (2006)18 developed a method to estimate a single ADL score from the ADL self-performance ratings in the MDS
- Carpenter (2006)[18] developed a method to estimate a single ADL score from the ADL self-performance ratings in the MDS

STUDY OBJECTIVE

- To evaluate the potential association between anemia with health-related quality of life (HRQOL) and activities of daily living (ADL) function in residents of LTC facilities

METHODS

STUDY DESIGN

- A retrospective cross-sectional study design was used to evaluate the association of anemia with HRQOL and ADL functioning

DATA SOURCE

- HIPAA compliant de-identified data was obtained from the AnalytiCare[SM] LTC database for residents in 27 nursing homes in the state of Colorado
- This database contained the following linked elements for each resident:
  - Laboratory results
  - MDS version 2.0 files
  - Pharmacy dispensing information

STUDY PERIOD

- 1/1/2007 to 9/15/2008

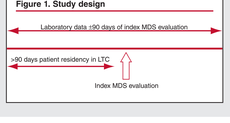
ELIGIBILITY CRITERIA

- **Inclusion criteria**
  - Index MDS available
  - Residency in LTC facility >90 days prior to index MDS (Figure 1)
  - Hemoglobin (Hb) and serum creatinine (sCr) values available ±90 days of index MDS
  - Documented age, gender, race and sCr to calculate estimated GFR (eGFR)
- **Exclusion criteria (as reported on MDS)**
  - Had diagnosis of cancer
  - Received chemotherapy
  - Received renal dialysis
  - Had a life expectancy of less than 6 months
  - Received hospice care during LTC stay

DEFINITIONS

- Index MDS
  - The earliest non-admission MDS assessment performed in the study timeframe
- Anemia
  - Hb value closest to the date of the index MDS was used to identify anemia status
    - This value was identified as the index Hb
  - Anemia was defined using the World Health Organization definition:[20]
    - Hb <12g/dL for females
    - Hb <13g/dL for males
- Hb Range
  - The index Hb for each resident was assigned to one of the following five ranges: hemoglobin <10g/dL, 10 to <11, 11 to <12, 12 to <13, 13+.
- HRQOL was assessed using the MDS-HSI
  - Derived from values reported in the index MDS, using the algorithm developed by Wodchis et al. (2003)[12]
    - Sensation, mobility, emotion, cognition, self-care, and pain
    - HSI = 0 to 1 health status index scale from Index MDS, where 1 = perfect health and 0 = dead
- ADL Score
  - Derived from values reported in the self-performance portion of Section G, using the algorithm developed by Carpenter et al.[18]
    - Performance of seven ADL items (bed mobility, transfer, locomotion, dressing, eating, toilet use and personal hygiene) are each reported in the MDS on a scale from 0 (independent) to 4 (total dependence)
    - The sum of the seven ratings yields a 0- to 28-point ADL score, where a higher score indicates lower ADL performance (greater dependence)

Figure 1. Study design



STATISTICAL ANALYSIS

- Stata (Intercooled 8.0, College Station TX) was used
- Unadjusted estimates of MDS-HSI and ADL score were compared through cross tabulation with both anemia status and hemoglobin range
- Regression Models
  - To control for underlying differences in many characteristics among residents who were anemic or not anemic, logistic regression, adjusted for other potential explanatory factors or covariates, was used to separately analyze the association of:
    - Anemia status with HSI and ADL score
    - Hb range with HSI and ADL score
  - The interaction of gender with anemia status was used in the anemia status model since the WHO definition requires consideration of gender in determining anemia
  - Backward elimination was used to retain those covariates with $P<.25$
  - Each logistic regression model adjusted for the following covariates prior to backward elimination:

Age Category	Cerebrovascular Accident	Peripheral Vascular Disease
Female	Congestive Heart Failure	Paraplegia
Race/Ethnicity	Emphysema/COPD	Parkinson's Disease
Educational Level	Dementia (not Alzheimer's)	Quadriplegia
Section 1 CKD or GFR Stage 3-5	Deep Vein Thrombosis	Seizure Disorder
Fell in Past 30 or 180 Days	Diabetes Mellitus	Transient Ischemic Attack
Alzheimer's Disease	Hemiplegia/hemiparesis	Anxiolytic/ Hypnotic/Antipsychotic
Arteriosclerotic Heart Disease	Hip Fracture	Antidepressant
Arthritis	Hypertension	Beta Blocker
Asthma	Missing Limb	Diuretic
Bone Fracture (Pathological)	Multiple Sclerosis	
Cerebral Palsy	Osteoporosis	

RESULTS

Table 1. Residents Characteristics

- Of the 1,460 residents who met study inclusion rules, 622 met 1 or more exclusion rules, leaving 838 eligible residents for analysis
- 46% of residents were anemic

	All n=838 % or mean (sd)	Non-Anemic n=452 % or mean (sd)	Anemic n=386 % or mean (sd)	*P*-value†
DEMOGRAPHICS				
Age, years	77.9 (12.4)	77.5 (12.9)	78.3 (11.8)	329
Female	67%	74%	59%	000
Race/Ethnicity				
White, not of Hispanic origin	82%	81%	82%	472
Black, not of Hispanic origin	5%	4%	5%	
Asian/Pacific Islander	2%	2%	1%	
Hispanic	12%	12%	12%	
Am Indian/Alaskan Native	0%	0%	0%	
Other	0%	0%	0%	
HEMOGLOBIN				
Hemoglobin level (g/dL)	12.4 (1.7)	13.6 (1.1)	10.9 (1.0)	000
Anemic (from index Hb, WHO definition)*	46%	0%	100%	000

Terms: WHO, World Health Organization
*WHO definition of anemia = index Hb <12 g/dL if female, <13 g/dL if male
†F-tests used for differences in means; Chi-square tests used for proportions.

Figure 2. Mean MDS-HSI by Hemoglobin Range

HRQOL AS ASSESSED USING MDS-HSI

- Of the 838 residents, 777 had non-missing data for all MDS elements required to calculate an HSI and were included in the HSI analyses
- Mean (SD) HSI for study residents was 0.431 (±0.169)
  - Mean (SD) HSI for the non-anemic population was 0.442 (±0.175)
  - Mean (SD) HSI for the anemic population was 0.418 (±0.161) [P=.048, t-test]

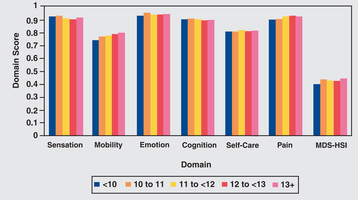


Figure 3. Mean ADL Score by Hemoglobin Range

ADL STATUS AS ASSESSED USING ADL SCOR

- Of the 838 residents, all had complete data for the 7 self-performance MDS elements required to calculate an ADL score and were included in the ADL analyses
- Mean ADL score for all study residents was 14.9 (sd=7.5)
  - Mean (SD) ADL score for the non-anemic population was 14.3 (8.0)
  - Mean (SD) ADL score for the anemic population was 15.5 (6.8) [P=0.014, t-test]

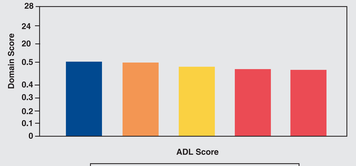


Table 2. Regression Model for Anemia Status and HRQOL as Assessed Using MDS-HSI

- Anemia was associated with a -0.03 lower HSI value when compared with the non-anemic reference case (P=.005)

	All Residents			
Variable	Coefficient	95% Lower Bound	95% Upper Bound	*P*-value
Anemic (Index Hb)	-0.03	-0.06	-0.01	005
Female	-0.03	-0.05	0.00	037
Age 65-74	-0.09	-0.13	-0.05	000
Age 75-84	-0.07	-0.10-	-0.03	001
Age 85+	-0.08	-0.12	-0.05	000
Black, not of Hispanic Origin	-0.05	-0.10	0.01	096
Asian/Pacific Islander	-0.10	-0.20	0.00	044
Tech School or Some	-0.04	-0.07	-0.01	021
Section I CKD or GFR Stage	0.02	-0.01	0.04	142
Fell in Past 180 Days	-0.05	-0.07	-0.03	000
Alzheimer's Disease	-0.09	-0.14	-0.05	000
Bone Fracture	-0.06	-0.12	0.00	064
Cerebral Palsy	-0.24	-0.56	0.07	133
Cerebral Vascular Accident	-0.03	-0.06	0.01	145
Hemiplegia	-0.06	-0.12	-0.01	026
Multiple Sclerosis	-0.12	-0.19	-0.05	001
Parkinson's Disease	-0.09	-0.20	0.01	081
Quadriplegia	-0.19	-0.31	-0.08	001
Seizure	-0.04	-0.10	0.01	119
Antidepressant Medication	-0.02	-0.04	0.01	221
Intercept	0.59	0.55	0.63	000

ADL Score (0-28 where higher score is worse score). Reference is not anemic, male, age <65 years, white race, not completed high school, GFR Stage 1-2 (from serum creatinien) or no MDS Section I CKD noted, not fallen in past 180 days, absence of conditions or drugs listed. Adj r^2= 0.1155

Table 3. Regression Model for Hemoglobin Range and HRQOL Assessed Using MDS-HSI

- This table shows findings for the adjusted model, this time substituting hemoglobin range for anemia status, and removing the interaction term with gender
- Compared to the reference value Hb (<10 g/dL), residents with hemoglobin levels ≥13 mg/dL had significantly better HSI scores (+0.03 points, P=.022) [not shown]

	All Residents			
Model*	Coefficient	95% Lower Bound	95% Upper Bound	*P*-value
Hemoglobin Level >13	0.01	0.05	0.00	0.004

*Reference hemoglobin stage is <10 g/dL. Only findings for hemoglobin stage are shown.

Table 4, Logistic Regression Model for Anemia Status and Activities of Daily Living (ADL) Score

- Anemia was associated with a 1.62 worse ADL score when compared to the non-anemic reference case (P=.001)

	All Residents			
Variable	Coefficient	95% Lower Bound	95% Upper Bound	*P*-value
Anemic (Index Hb)	1.62	0.63	2.62	001
Female	1.66	0.60	2.71	002
Age 65-74	2.94	1.17	4.72	001
Age 75-84	4.00	2.41	5.58	000
Age 85+	4.57	2.96	6.18	000
Black, not of Hispanic Origin	2.18	-0.17	4.53	069
Asian/Pacific Islander	4.01	0.27	7.75	036
Tech School or Some College	1.50	0.16	2.84	029
College Grad or Advanced	1.45	-0.15	3.04	075
Section I CKD or GFR Stage 3-5	-1.20	-2.22	-0.18	022
Fell in Past 180 Days	1.30	0.34	2.26	008
Alzheimer's Disease	2.52	0.52	4.51	014
Bone Fracture	2.03	-0.66	4.71	139
Cerebral Palsy	18.87	5.06	32.68	007
Cerebral Vascular Accident	2.65	1.18	4.13	000
COPD	1.43	-0.16	3.02	078
Diabetes Mellitus	0.75	-0.33	1.84	174
Hemiplegia	3.78	1.45	6.12	002
Multiple Sclerosis	7.54	4.51	10.56	000
Parkinson's Disease	3.65	-0.99	8.30	123
Quadriplegia	9.90	4.92	14.87	000
Seizure	1.78	-0.58	4.13	139
Transient Iscemic Attack	-4.06	-9.35	1.23	132
Antianxiety/Hypnotic/Antipsych	-1.28	-2.96	0.41	138
Antidepressant Medication	0.85	-0.55	2.25	234
Intercept	7.78	5.82	9.75	000

ADL Score (0-28 where higher score is worse score). Reference is not anemic, male, age <65 years, white race, not completed high school, GFR Stage 1-2 (from serum creatinien) or no MDS Section I CKD noted, not fallen in past 180 days, absence of conditions or drugs listed. Adj r^2= 0.1464

Table 5. Logistic Regression Model for Hemoglobin Range and Activities of Daily Living (ADL) Score

- This table shows findings for the adjusted model, this time substituting hemoglobin range for anemia status, and removing the interaction term with gender
- Compared to the reference value Hb (<10 g/dL), residents with Hb levels ≥12 mg/dL had significantly better ADL scores (-1.70 to -2.16 points, P=.021)

	All Residents			
Model*	Coefficient	95% Lower Bound	95% Upper Bound	*P*-value
Hemoglobin Level 11 to <12	0.76	0.37	0.00	-2.623
Hemoglobin Level 12 to <13	0.74	-0.25	0.00	-3.142
Hemoglobin Level >13	0.69	-0.81	0.00	-3.517

*Reference hemoglobin stage is <10 g/dL. Only significant findings for Hb stage are shown.

LIMITATIONS

- These observations are limited to residents in the state of Colorado
  - The characteristics of LTC residents and the health care providers in other states may be different
- The assessments of HSI and ADLs were dependent on the MDS entries rather than direct observations in a study environment
- Anemia status was determined only by the index Hb value, so the chronicity of anemia was not determined
- The impact of anemia interventions was not evaluated
- The regression models only tested a linear association between anemia/hemoglobin range and the outcomes of HSI/ADL score
  - Non-linear regression models (e.g. quantile regression) or transformations of the HSI and ADL scores might have found associations not revealed in this analysis

CONCLUSIONS

- Findings from this study suggests that anemia was associated with:
  - Lower HRQOL as assessed using the MDS-HSI
    - In the adjusted model, this difference was 0.03 points.
    - A difference of this magnitude for the Health Utilities Index instruments has been identified by Drummond et al.[21] and Grootendorst et al.[22] as clinically important
- Greater impairment of functional status as assessed using ADL scores
  - In the adjusted model, this difference was 1.62 points
  - A difference of this magnitude for exceeds the 1-point ADL score threshold that Carpenter et al.[18] have identified as clinically meaningful
- Further study on the association between anemia and anemia severity on HRQOL and functional status in LTC residents is warranted

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Disclosures

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