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Anemia and Associated Risk Factors for Poor Cognitive Function in Elderly Patients

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Abstract
Background: *Anemia is common in older adults aged 65 years and older, associated with morbidity, mortality, and increases the risk for cognitive decline [1]. The aim of the study was to evaluate the association between anemia and risk factors for poor cognitive function in elderly patients.*
Patients and method*: This study included one hundred elderly patients at internal medicine department in Assiut University hospital, which chosen randomly for three months from the first of January 2018 to the end of March 2018. Each elderly patients were assessed through socio-demographic data, hemoglobin level, activities of daily living (ADL), Mini-Mental State Examination (MMSE), Body mass index (BMI) and Charlson Comorbidity Index (CCI)*
Results: *Anemia was shown in 78 % of patients, in comparison to patients without anemia, anemic patients showed significantly poor MMSE score (19±3.4 vs. 24±2.5; p<0.001), high CCI (3.7±1.2 vs. 2.8±0.85; p=0.001) and associated with severe functional impairment (38.5%vs 13.8%; p<0.001). A significant negative correlation between MMSE scores with age (r= -0.357, p<0.001) and CCI (r= -0.508, p<0.001) were detected.*
Conclusion: *Older age, low education level, anemia, and comorbidity are predictive for impaired cognitive function. Increased BMI and full daily activities are protective against cognitive function impairment. Recommendation: Health education program for elderly regarding the causes, risk factors and treatment of anemia.*
Keywords: *anemia; elderly, cognitive capacity; comorbidity; activities of daily living*

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I. Introduction

Anemia in the elderly has been related to a higher rate of cardiovascular infection, cognitive hindrance, diminished physical execution and nature of life [1]. Elderly patients with disabled cognitive capacity have a high pervasiveness of comorbidities that assume a role in the pathogenesis and furthermore in the progress of dementia [2]. The undetected comorbidities will cause functional impairment, low quality of life and higher mortality [3]. Early acknowledgment and treatment of various comorbidities by clinicians will enhance the personal satisfaction in seniorpeople [3].

Gaskell et al 2008, revealed that the mean pervasiveness of anemia among older adults in created nations was 12% in community residence aged, 40% in clinic affirmations, and 47% in nursing homes dwellers [4].

Anemia in old age people ascribed to inadequate nourishment, chronic diseases andother different causes. Iron deficiency had the immediate neurochemical impact on cognizance and furthermore had a modifiable hazard factor for both dementia and for poor discernment in elderly [5].

Epidemiologic investigations propose that cognitive capacity is enhanced with normal physical exercise. Exercise enhances cerebral blood stream and neuronal network and maintains mind volume. With advanced age, the capacity to perform everyday living exercises without help decides freedom and generally shows personal satisfaction [6, 7].

Pang &Schrier 2012 revealed that anemia is normal in the old age group; it has been related to generous bleakness and mortality. , Also iron deficiency is related to changes in personal satisfaction, expanded the danger of falls, diseases, and diminished discernment and physicalability [8].The point of this investigation is to assess the relationship between iron deficiencies, hazard variables for poor cognitive capacity in elderly patients.

Research Question
Elderly patients with anemia have a decreased attributable cognitive functions and decreased attributable daily duties.

Patients
The research design: The descriptive cross-sectional research design was used in the study; it was accomplished at internal medicine department in Assiut University hospital, Assiut governorate, which involve homogenous elderly patients with the same nationality that had the same inclusion criteria, the study achieved in three months from the first of January 2018 to the end of March 2018, the study participants were randomly selected based on convenient method which included one hundred elderly patients whose most available to chosen.

Inclusion criteria: included elderly people whose age 60 years and more from both males and females with interminable diseases as hypertension, diabetes, congestive heart failure, coronal heartdisease, chronic occlusive pulmonary disease, a blood disorder, hypothyroidism, under nutrition, and interminable renal failure.

Exclusion criteria: the elderly patients with psychological disorder, history of the cerebrovascular incident (hemorrhage, coma, transient ischemic attacks) terminal illness and active bleeding.

Socio-demographic dataincludes: Socio-demographic data sheet included name, age, sex, level of education, occupation, marital status, occupation before retirement, etc. Past medical history was taken from the elderly as diabetes mellitus, hypertension, heart disease, atrial fibrillation, respiratory disorder, rheumatic disorder, dementia, urinary tract infection, and kidney disease.

Laboratory features: It includes Hemoglobin level (Hb level) as the initial cognitive task assessment. Anemia was appointed according to the World Health Organization criteria of Hb<13 g/dl in men or Hb<12 g/dl in women.

Mini-Mental State Examination (MMSE): Aconcise estimationof the cognitive task of elderly patients. This scale includes five items (orientation, registration, Attention &calculation, recall, and language). The Cronbach's alpha for reliability was 0.85. The total score for this scale is 30 degree. A score lower than 18 correspond to severe cognitive vulnerability, 19–23 means moderate cognitive hindrance and higher than 24 mean normal cognitive tasks [10].

Anthropometric measurements: Body Mass Index(BMI) was counted as weight (kilograms) divided by height (meters) squared and labeled according to the World Health Organization categories:
Underweight = <18.5
Normal = 18.5-24.9
Overweight = 25.0-29.9
Obesity = < 30.0

Functional dependence measurement: Functional reliance gauged by the Katz Index of Independence of ADL. The Index ranks adequacy of performance in the six measures of bathing, dressing, toileting, transferring, continence, and feeding. The Cronbach's alpha for reliability was 0.87. A score of 6 means full function, 4 point indicates moderate impairment, and 2 or less indicates very much indeed functional impairment [11].

Comorbidity assessment: The CharlsonComorbidity Index(CCI) was calculated by reviewing the patient's medical records, The CCI is an age-dependent prognostic score based on 17 disease categories.The Cronbach's alpha for reliability was 0.91. Patients were divided into four groups: patients without any comorbidity; mild with CCI scores of 1–2; moderate with CCI scores of 3–4; and severe with CCI scores ≥5 [12].

II. Method

Administrative phase: An approval formal letter was taken from the Dean of the Faculty of Nursing, Assiut University to the Director of the medical department at Assiut University hospital to complete the study. The letter included a permission to carry out the study in the selected area.

Pilot study: The pilot study was achieved before starting of data collection on (5) elderly patients. The aim of this study is to determine the clarity and applicability of the tools and to estimate the exact time to fill the

questionnaire. Based on the results of the pilot study, some questions were restated regarding history and added new questions regarding comorbidity, therefore this sample were getting away from the study.

Ethical considerations: The research proposal was approved from the ethical committee in the Faculty of Nursing, Assiut University. There is no hazard for study subjects during the application of the research.

Fieldwork: After obtaining permission, data was collected using an interview structured questionnaire. The items in the questionnaire were included socio-demographic data, past medical history, knowledge, and assessment of perceptive tasks and daily duties of elderly patients and calculating body mass index for each patient. The elderly were interviewed individually to complete the items of the questionnaire. Average time taken for each patient ranged from 10-20 minutes about 4 cases in the day.

Statistical analysis: Data was described as means ± standard deviation for numeric variables and relative frequencies for categorical variables. The difference of categorical variables was assessed by Pearson's x2-test. Due to non-normality of some continuous variables, non-parametric tests (Mann–Whitney U-test and Spearman's rank correlation coefficient) were used as appropriate. Linear regression modeling was performed to assess the independent effect of variables on MMSE score. Variables with $P < 0.05$ in univariate regression were included in the multivariate model. A p value of <0.05 was considered as significant. Data analysis was calculated by the Statistical Package for Social Science (SPSS) version 22.

III. Results

Table (1): Prorating socio demographic information of the studied sample

Socio demographic data	N= 100	%
Age		
60-64	51	51%
65-69	17	17%
70 >	32	32%
Mean± SD(rang)	66.5±6.8 (60-90)	
Sex		
Male	61	61%
Female	39	39%
Marital Status		
Married	91	91%
Widow	9	9%
Level of education Illiterate	66	66%
Educated	34	34%
Living Status Alone	9	9%
With family	91	91%

Table (1): Represents that more than half of the studied sample (51%) their ages ranged from 60 to 64 years with mean of age (66.5±6.8 (60-90) , while 61% of them were male. As regards educational level, it was observed that 66% of the studied samples were illiterate. Concerning living status, the vast majority of them (91%) live with family.

Table (2): Distribution of the studied sample as regard Activities of daily living scale (ADLS), Hemoglobin level, Mini Mental State Examination (MMSE), and Body Mass Index (BMI).

Variables	N=100	%
Activities of daily living scale (ADLS)		
-Severe functional impairments	33	(33%)
-Moderate functional impairments	42	(42%)
-Full function	25	(25%)
Laboratory Features (Mean± SD(rang)		
Hemoglobin level(Hb)-	10.6±6.5 (3.9-16)	
Body Mass Index (BMI) (Mean± SD(rang)	24.3±2.2(18.7-32.6)	
MMSE(Mean± SD(rang)	20.2±3.9	

Table (2): This table shows that one third of the studied sample (33%) had severe functional impairments, 42% of them had moderate functional impairment and one quarter of them (25%) had full function with MMSE **(Mean± SD (rang)** 20.2±3.9. with mean of hemoglobin level 10.6±6.5 (3.9-16).

Table (3): Sociodemographic data, Activities of daily living scale (ADLS), Hemoglobin level, Mini Mental State Examination (MMSE), Body Mass Index (BMI) and Charlson Comorbidity Index (CCI) of the patients stratified by presence of anemia**.**

Variables		Anemia		p-value
		Yes N=78 (78%)	No N=22 (22%)	
Sex	Male	50(64.1%)	11(50%)	0.231
	Female	28(35.9%)	1(50%)	
marital status	Married	73(93.6%)	18(81.8%)	0.088
	Widow	5(6.4%)	4(18.2%)	
level of education	Illiterate	54(69.2%)	12(54.5%)	0.199
	Educated	24(30.8%)	10(45.5%)	
ADL	severe functional impairments	30(38.5%)	3(13.6%)	0.001*
	moderate functional impairments	35(44.9%)	7(31.8%)	
	full function	13(16.7%)	12(54.5%)	
Age mean±SD(rang)		66.4±6.6	67±7.4	0.837
Hb		9.2±1.9	13.2±1.2	<0.001*
BMI		24.2±2	24.6±2	0.332
MMSE		19±3.4	24±2.5	<0.001*
CCI		3.7±1.2	2.8±0.85	0.001*

Table (3): Illustrate that anemia was presented in (78 %) of patients more than two thirds of them were male and illiterate. Compared to patients without anemia, patients with anemia showed significantly poor MMSE score (19±3.4 vs. 24±2.5; p<0.001), high CCI (3.7±1.2 vs. 2.8±0.85; p=0.001) and associated with severe function impairment (38.5%vs 13.8%; p<0.001), No difference was noted between the two groups as regard age, gender, marital status, level of education and BMI.

Table (4): Correlation between Mini Mental State Examination (MMSE), and other variables by spearman correlation.

Variable	95% Confidence Interval(Lower- Upper)	Correlation Coefficient	P -value
Age	(-0.520- -0.163)	-0.357	<0.001*
Hemoglobin level	(0.448- 0.743)	0.620	<0.001*
BMI	(-0.028- 0.364)	0.181	0.072
CCI	(-0.653- -0.338)	-0.508	<0.001*

Table (4): Shows that the association between MMSE score and other factors, there was significant negative correlation between MMSE scores (r= -0.357, p<0.001) and CCI (r= -0.508, p<0.001) with increasingage. The MMSE scores increased proportionally to hemoglobin level (r=0.620, p=<0.001). Correlation between BMI and MMSE scores was also done and it was found to be insignificant (r=0.181, p=0.072).

Table (5): Univariate regression analysis of prognostic factorsthat affecting MMSE score of the patients.

Variable	Unstandardized B (Standardized B)	p-value
Age	-0.184(-0.323)	0.001*
Sex (female)	-0.256(-0.032)	0.744
Marital status	1.002(0.074)	0.463
level of education (educated)	1.625(0.199)	0.047*
Hemoglobin level	0.926(0.585)	<0.001*
BMI	0.467(0.259)	0.009*
ADL (full function)	1.559(0.607)	<0.001*
CCI	-01.426(-0.450)	<0.001*

Table (5): As shown in Table 5, in linear regression modeling, age, level of education, hemoglobin level, BMI, full ADL and CCI were independently associated with MMSE score with P < 0.05 in univariate analysis.Advanced age and high CCI comorbidity score were negative independent predictive factors of cognitive function. High education level, higher activity and high BMI were positive independent predictive factors of cognitive function.

Table (6): Results of multivariate linear regression analysis of prognostic factors affecting MMSE score of the patients.

Variable	Unstandardized B (Standardized B)	p-value
Age	-0.096(-0.169)	0.022*
level of education(educated)	1.164(0.143)	0.024*
Hemoglobin	0.660(0.417)	<0.001*
BMI	0.403(0.223)	0.001*
ADL(full function)	0.993(0.387)	<0.001*
CCI	-0.217(-0.068)	0.346

Table (6): shows that multivariate analysis by linear regression for prognostic factors affecting MMSE score of the patients revealed that among 6 factors with potentially significant effect in univariate analysis, 5 factors were found to independently predict MMSE score values.

IV. Discussion

In the present examination, the pervasiveness of anemia was 78%, MMSE score and ADL scores in the anemic group were less than in patients who had normal hemoglobin levels. Also CCI was higher in anemic patients than others. These finding are consistent with results of previous series [14-18].

Our investigation demonstrates a huge relationship between MMSE score and CCI Score, higher CCI score is related todecline MMSE scores. These outcomes are assilay et al (2017) that revealed each one point augment on CCI was related to a 3.1 overlap expanded danger of cognitive morbidity [3]. Another examination detailed an expanded number of comorbidity among patients with dementia than patients without dementia [19].On the other hand, one study(2) demonstrated that dementia patients are physically fit more than patients without dementia. Another investigation demonstrated no distinctions in general comorbidity between patients with and without dementia [2, 20].

In the present examination low hemoglobin levels were considered as a potential contributing component to cognitive capacity hindrance.Males had anemia>females but this statistical insignificant (p=0.2) and mean hemoglobin in males > females (10.2mg/dl versus 9.7mg/dl, p= 0.27), these results may be due to males had mean ages higher than females (67 versus 65) and absence of risk factors among females as menstruation.

Systematic reviews supported the relationship between anemia on cognitive functions [5, 21].Furthermore, evidence for the association between red blood cell measures normally indicative of anaemia and measures of both poor cognitive performance and of dementia has been studied [13].

In agreement with other series, the multivariate analysis, older age and lower education were risk factors for impaired cognitive function. Large waist circumference was a protective factor for cognitive function [22, 23].

The present results suggested that full function of ADL had a protective effect against poor cognitive function which supported by a systematic review of Carvelho, (2014) [24]. A recent study suggested that all cognitive measures were related to indices of mobility, indicating a global association that often increased with age [25]. Another results revealed that the combined effect of higher physical activity and cognitively active sedentary behavior showed the lowest risk of cognitive function among community-dwelling older adults [26].

Limitations: Further prospective studies are needed to identify the cause-and-effect relationship of the risk factors and cognitive function. Also large number of patients might be beneficial to detect the impact of each comorbidity on cognitive function.

V. Conclusion and Recommendations

As the life of the world population accelerates, we should design strategies for the protection and handling of changeable risk factors affecting cognitive function hindrance. The point of this investigation was to assess the relationship between iron deficiencies and hazard variables for poor cognitive capacity in elderly patients. The results revealed that increased age, low educational level, anemia, and increased comorbidity are risk factors for presenting poor cognitive function. Increased BMI and full daily activities are protective against cognitive function morbidity. Implementing health education programs for seniorsand their caregivers regarding the causes, risk factors, early diagnosis and treatment of anemia, screening to identify the high risk group and early prevention.

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