MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2026.1.6.13

Association between Comprehensive Geriatric Assessment Scores, Body Composition and Metabolic Profiles in Geriatric in Patients: A Cross-Sectional Study from a Tertiary Care Setting in Kolkata

[1]Arunansu Talukdar, [2]Dr. Payel Talukdar, [3]Dr. Anindya Mukherjee, [4]Dyutipravo Bhowmik and [5]Upasana Ghosh

[1]Department of Geriatric Medicine Department, Medical College and Hospital, Kolkata, India

[2]Department of Psychiatry, RG Kar Medical College and Hospital, Kolkata, India

[3]Department of Community Medicine, Medical College and Hospital, Kolkata, India

[4]Medical College and Hospital, Kolkata, India

[5]Department of Geriatric Medicine, Medical College and Hospital, Kolkata, India

OPEN ACCESS

Key Words
Comprehensive Geriatric assessment, elderly, nutritional assessment, obesity, polypharmacy, sociodemographic factors, metabolic parameters

Corresponding Author
Dr Anindya Mukherjee, Associate Professor, Dept of Community Medicine, Medical College Kolkata

Author Designation
[1]Professor and Head,
[2]Associate Professor,
[3]Research Assistant
[4]MBBS Final Year Student
[5]Research Assistant

Received: 20th May 2026
Accepted: 10th June 2026
Published: 14th July 2026

Citation: Arunansu Talukdar, Dr. Payel Talukdar, Dr. Anindya Mukherjee, 2026. Association between Comprehensive Geriatric Assessment Scores, Body Composition and Metabolic Profiles in Geriatric in Patients: A Cross-Sectional Study from a Tertiary Care Setting in Kolkata. Res. J. Med. Sci., 20: 6-13, doi: 10.36478/makrjms.2026.1.6.13

ABSTRACT

To assess the association between Comprehensive Geriatric Assessment (CGA) parameters and sociodemographic, clinical, anthropometric and metabolic variables among elderly patients. A cross-sectional study was conducted among elderly patients (n = 100) using validated tools (MMSE, GDS, MNA, Morse Fall Risk Score and Barthel Index). Sociodemographic, clinical, In Body-derived anthropometric and biochemical metabolic variables were analyzed using chi-square and ANOVA tests. The most common age group was 60-69 years and males constituted a slightly higher proportion (69%). Urban residence (51%) was more prevalent than rural, and the education level was mostly up to primary school (52%). MMSE showed significant association with education (p = 0.038); GDS with urinary incontinence (p = 0.026); MNA with polypharmacy (p = 0.019) and education (p = 0.034); ADL (Barthel Index) with perceived pain (p = 0.04) and Morse Fall Risk with pain (p = 0.013). Among metabolic variables, MNA and ADL were significantly associated with total cholesterol (p = 0.004); (p = 0.02) ANOVA revealed percent body fat significantly influenced MNA (p = 0.04), highlighting the link between sarcopenic obesity and nutrition. Findings reflect strong interplay between physical, nutritional and metabolic domains of elderly health. CGA domains are influenced by demographic and metabolic variables, emphasizing the need for integrated geriatric screening, nutritional intervention and preventive policy measures.

INTRODUCTION

The global population is undergoing a marked demographic transition. The proportion of adults aged = 60 years is rising rapidly, particularly in low-and middle-income regions including India[1–4]. This shift is accompanied by higher burdens of multimorbidity, functional limitations and complex care needs that strain health systems[1,4,9]. Ageing entails characteristic alterations in body composition-declining skeletal muscle mass and strength increasing adiposity (often visceral) and shifts in fluid and mineral balance-together with metabolic dysregulation that collectively elevate risks for sarcopenia, frailty, disability and cardiometabolic disease[10–13,25].

Comprehensive Geriatric Assessment (CGA) offers a multidimensional framework to detect and manage functional, cognitive, affective, nutritional and psychosocial impairments that are often missed in organ-specific evaluations[1,4]. Validated instruments in CGA such as the Mini-Mental State Examination (MMSE), Geriatric Depression Scale (GDS), Mini Nutritional Assessment (MNA), Morse Fall Risk Scale and the Barthel Index provide standardized measures of cognition, mood, nutrition, fall risk and activities of daily living, respectively[5-9]. Concurrently, objective profiling of body composition via. Bioelectrical Impedance Analysis (BIA)-including indices such as BMI, skeletal muscle mass, percent body fat, fat-free mass and basal metabolic rate-adds physiological context to CGA domains and helps identify sarcopenia and sarcopenic obesity phenotypes relevant to outcomes[10-12,21]. Routine metabolic markers (random blood glucose, lipid fractions, bilirubin, urea, creatinine and electrolytes) reflect systemic status that may track with function, mood and nutrition among older adults[18-20,25].

Rationale/Justification: There is limited integrative evidence from Indian inpatient settings that links specific CGA domains with BIA-derived body composition and metabolic panels to inform actionable care[14–16,18-20]. Establishing these relationships using pragmatic tools (e.g., InBody-type BIA and basic biochemical assays) could enable earlier risk detection, stratification and targeted interventions in resource-constrained hospitals serving ageing populations[1-4,10-12,18-20]. Moreover, synthesizing CGA with composition and metabolic phenotypes can clarify pathways connecting malnutrition,sarcopenia/sarcopenicobesity, depressive symptoms, pain/falls and disability, thereby guiding comprehensive geriatric models of care[12,17–20,23].

Why the Geriatric Population: Older inpatients disproportionately accumulate interacting physical, cognitive and psychosocial vulnerabilities that drive dependence, rehospitalization and reduced quality of life.

A CGA-anchored, physiology-informed approach is therefore most impactful in this group[1,4,9]. Evidence from Indian and international cohorts shows strong links between education and cognition, incontinence and psychological distress, pain and disability, nutrition and function and lipid status with geriatric syndromes-relationships most salient in later life and amenable to tailored interventions[14–20,23].

Scope of the Present Study: Accordingly, we evaluated selected CGA components-MMSE, GDS, MNA, Morse Fall Risk and ADL (Barthel Index)-in relation to sociodemographic and clinical variables using chi-square tests and examined their associations with BIA-derived body composition indices and metabolic parameters in a cohort of hospitalized older adults in a tertiary-care setting in Kolkata [5–9,10–12,14–16,18–21]. This integrative design aims to generate locally relevant evidence to support targeted nutritional, physical and medical interventions within CGA-based geriatric services[1–4,7,10–12,18–20].

Objectives: The general objective of this study is to assess and evaluate body composition—including muscle mass, BMI, fat distribution, water content, protein and mineral levels and metabolic profiles consisting of random blood sugar, total cholesterol, HDL cholesterol, triglycerides, total bilirubin, urea, creatinine, calcium, phosphate, sodium and potassium among elderly patients. The aim is to correlate these physiological and biochemical parameters with outcomes from selected components of the Comprehensive Geriatric Assessment (MMSE, GDS, MNA, Morse Fall Risk Score and ADL) in order to derive actionable insights for improving healthcare strategies. Specifically, the study aims to assess the body composition of elderly patients using the InBody270 device which operates via. bioelectrical impedance analysis to evaluate their metabolic profile through standard laboratory tests to identify and analyze significant statistical associations between these variables and CGA outcomes using chi-square tests and to provide clinical insights that may guide individualized interventions and management strategies within a tertiary care setting.

MATERIALS AND METHODS

This was a cross-sectional clinical study conducted between July 2024 and July 2025 in the Geriatric Medicine Department of a tertiary care teaching hospital in Kolkata. A total of 100 elderly inpatients aged 60 years and above were included using systematic random sampling. Patients who were clinically stable, able to consent and willing to

participate were recruited while those with severe cognitive impairment, acute illness or refusal to participate were excluded. The sample size was calculated using Cochran's formula for cross-sectional studies:

$n = Z2p(1-p)/r^2 = 97$, rounded off to 100 participants, after obtaining ethical clearance and informed consent, data were collected through direct interviews using a structured questionnaire, clinical examination and investigation reports. Sociodemographic and clinical variables were recorded, followed by measurement of height, weight and BMI. Body composition was assessed using the InBody270 device which utilizes bioelectrical impedance analysis to estimate skeletal muscle mass, fat mass and distribution, total body water, protein and mineral content. Blood samples were analyzed for random blood sugar, total cholesterol, HDL cholesterol, triglycerides, total bilirubin, urea, creatinine, calcium, phosphate, sodium and potassium.

Selected components of the Comprehensive Geriatric Assessment were evaluated including the Mini Mental State Examination (MMSE), Geriatric Depression Scale (GDS), Mini Nutritional Assessment (MNA), Morse Fall Risk Score and Activities of Daily Living (ADL) using the Barthel Index. Data were analyzed using SPSS software. Continuous variables were categorized based on clinical thresholds and chi-square tests were applied to assess associations between CGA outcomes and sociodemographic, clinical, body composition and metabolic parameters. A p-value <0.05 was considered statistically significant.

To further explore continuous variable differences across CGA categories, one-way ANOVA was performed. Where significant differences emerged, post hoc analysis was conducted by fixing one variable at a time, thereby allowing more precise identification of subgroup variations and clarifying the direction of associations.

RESULTS AND DISCUSSION

Data from 100 inpatients aged 60 years and above were analyzed. The study explored associations between components of Comprehensive Geriatric Assessment (CGA) and various sociodemographic, InBody and metabolic parameters. Among the participants, the most common age group was 60-69 years and males constituted a slightly higher proportion. Urban residence was more prevalent than rural and the education level was mostly up to primary school or illiterate. There was no addiction in most participants and weight loss was not significant. From clinical history of participants loss of appetite, polypharmacy, mild sleep disturbances, urine incontinence and mild perceived bodily pain were commonly reported while bowel irregularities had lower frequencies. This table provides a baseline profile of the study population.

Table 1: Distribution of Sociodemographic and Clinical Variables (n = 100)

Research Parameters		Frequency	Percentage (%)
Sex	Male	69	69
	Female	31	31
Address	Rural	49	49
	Urban	51	51
Education level	Below primary	52	52
	Middle school	26	26
	Above secondary	22	22
Wt loss	Significant	49	49
	Non significant	51	51
Addiction	Yes	36	36
	No	64	64
Multiple addiction	Not applicable	64	64
	Yes	24	24
	No	12	12
Sleep disturbance	No	30	30
	Mild	32	32
	Moderate	24	24
	Severe	14	14
Urine incontinence	No	49	49
	Yes	51	51
Bowel irregularities	Normal	44	44
	Incontinence	21	21
	Constipation	35	35
Perceived pain	Mild	73	73
	Moderate	13	13
	Severe	14	14
Loss of appetite	Yes	57	57
	No	43	43
Polypharmacy	Yes	56	56
	No	44	44
MMSE GROUP	Normal	51	51
	Mild	29	29
	Moderate	20	20
GDS GROUP	Normal	43	43
	Mild	32	32
	Moderate	15	15
	Severe	10	10
Morse fall Risk group	Low	39	39
	Moderate	41	41
	High	20	20
MNA group	Normal nutrition	5	5
	At risk	36	36
	Malnourished	59	59
ADL Barthel group	Severe dependence	1	1
	moderate dependence	67	67
	slight dependence	32	32

From CGA scores most participants had normal MMSE, GDS scores but most had moderate Morse fall risk, low nutrition and moderate dependence for activities of daily living [Table 1].

This table shows the maximum and minimum values, mean, standard deviation, skewness and kurtosis for each variable. Among all variables: BMR, recommended calorie intake, Random Blood glucose, Triglycerides and Total Cholesterol exhibited maximum standard deviation indicating high variability across individuals.

In terms of skewness, sodium levels, urea and creatinine showed notable skew, reflecting a non-symmetric distribution in the population. These findings highlight the heterogeneity in metabolic and bosdy composition profiles among older adults [Table 2].

Chi-square analysis revealed significant relationships between specific CGA components and

Table 2: Descriptive Statistics of CGA, In Body and Metabolic Parameters

	Descriptive Statistics					
	Minimum	Maximum	Mean	SD	Skewness	Kurtosis
Age	53	86	67.51	7.1145	0.618	-0.289
MMSE(30)	13	30	23.12	4.4547	-0.498	-0.788
GDS(15)	0	15	5.56	4.0609	0.581	-0.418
Morse(125) Fall Risk	0	70	29.58	16.0216	0.366	0.03
Mini nutritional assessment(14)	0	13	6.15	3.5058	-0.07	-1.017
ADL (Barthel)(20)	12	20	17.21	2.0216	-0.338	-0.764
Instrumental(8) ADL	1	9	5.02	2.2427	-0.124	-1.178
Total body water(L)	18.3 0.063	46.6	28.902	5.0433	0.293	
Minerals(kg)	1.25	4.65	2.8441	0.59136	0.089	0.101
BMI(kg/m2)	15.7	32.9	23.55	3.4534	-0.099	0.063
Skeletal muscle mass	12.2	33.4	21.363	4.0191	0	-0.538
Percent body fat	3.6	52.8	29.25	9.4066	0.083	0.047
Waist hip ratio	0.45	1.1	0.8608	0.12655	-0.969	0.781
Visceral fat level	1	20	8.26	4.5894	0.606	-0.507
Fat free mass	24.9	63	38.325	6.9316	0.429	0.263
Basal metabolic rate	840	1732	1220.73	154.9057	0.178	-0.029
Recommended calorie intake	1090	2500	1857.83	319.7159	-0.365	-0.376
Random blood glucose(MG/DL)	95	234	149.17	27.2334	0.907	0.763
Total cholesterol	88	212	145.9118	25.92685	0.035	-0.411
HDL cholesterol	16.72	80	37.7989	11.65043	0.99	1.567
Triglycerides	67.95	308	146.4619	33.92414	0.716	4.291
Total Bilirubin	0.1	3.1	0.79452	0.52601	1.875	4.905
Urea	14.3	116	34.3632	20.77737	2.326	5.559
Creatinine	0.1	7.8	1.2854	1.13845	4.028	20.109
Calcium	2.2	10.6	8.2902	1.65973	-1.899	3.628
Phosphate	1.2	6.52	2.8162	0.8094	1.526	4.89
Sodium	1.22	146	133.4522	14.85843	-7.283	64.349
Potassium	2.1	5.3	3.732	0.61874	-0.318	-0.045

Sociodemographic or clinical features: MMSE and Education Level (p = 0.038): Higher cognitive scores were strongly associated with better education. GDS and Urinary Incontinence (p = 0.026): Suggests depression may correlate with continence issues. Morse Fall Risk Score and Perceived Pain (p = 0.013): Fall risk was higher in those experiencing more pain. MNA with both Polypharmacy (p = 0.019) and Education (p = 0.034): Poor nutrition was linked to medication burden and lower education. ADL (Barthel Index) and Perceived Pain (p = 0.04): Pain adversely affected daily functional independence. These findings underscore the interdependence of psychosocial, functional and clinical health in the elderly [Table 3].

ANOVA was performed between five CGA domains (MMSE, GDS, MNA, ADL-Barthel, Morse Fall) and In Body parameters (BMI, skeletal muscle mass, fat %, Waist Hip Ratio, fat-free mass, Basal Metabolic Rate). A statistically significant relationship was found between Percent Body Fat and MNA scores (p = 0.04). No other In Body parameters showed statistically significant differences across CGA domains. This suggests a possible connection between malnutrition and altered body fat composition in elderly individuals.

Post Hoc Analysis of MNA vs. Percent Body Fat was conducted to analyze differences in percent body fat across three MNA groups (normal at risk, malnourished). Holding one group constant, the other two were compared step-by-step. Significant increases in body fat were observed as nutritional status declined, suggesting inverse trends between malnutrition and lean body composition [Table 4].

ANOVA assessed the relationship between CGA components and various blood-based metabolic markers. MNA vs. Total Cholesterol (p = 0.004): Significantly associated, indicating a link between nutritional status and lipid profile. ADL (Barthel Index) vs. Total Cholesterol (p = 0.02): Also significant possibly reflecting the role of cholesterol metabolism in functional independence. These findings may have clinical implications in managing metabolic health to support nutritional and functional well-being.

Post Hoc Analysis of MNA vs. Total Cholesterol were made across MNA categories: Cholesterol levels increased progressively from normal nutrition to malnourishment. This paradoxical trend may relate to unbalanced diets, metabolic disorders or statin use. Due to limited group-wise data distribution, post hoc analysis for ADL (Barthel Index) and Total Cholesterol could not be performed [Table 5].

Our study aimed to explore associations between components of the Comprehensive Geriatric Assessment (CGA) and sociodemographic, clinical and metabolic parameters in elderly individuals. The findings have been analyzed in light of previous studies for better contextual understanding.

Gender Distribution: In our study, males formed the majority of the sample. Similar male predominance was observed in studies by Singh *et al*.[1], Bogner and Gallo[3], Kim *et al*. [6] and Chien *et al*.[7]. Conversely, studies by Tripathi and Tiwari[2] and Vellas *et al*.[5] reported higher female participation, possibly due to sampling variations or regional demographic differences.

Cognitive Function (MMSE) and Sociodemographic Correlation: Our study found significant associations between MMSE scores and education level, similar to findings by Singh *et al*.[1] and Tripathi and Tiwari[2], both of whom reported cognitive impairment being more prevalent among less educated elderly.

Urinary Incontinence and Psychological Impact: We observed a significant correlation between urinary incontinence and GDS scores, suggesting an impact on mood. This is supported by the findings of Bogner and Gallo[3] who found urinary incontinence to be strongly associated with psychological distress. Pain and Functional Limitation (Barthel Index): Pain was associated with decreased ADL scores in our study. This aligns with the results from Eggermont *et al*.[4] who showed that multisite pain predicted functional

Table 3: Association between CGA Parameters and Socio demographic /Clinical Variables (Chi-Square Test)

		MMSE			GDS				Morse fall			MNA			ADL(BARTHEL)		
		normal	mild	moderate	normal	mild	moderate	severe	low	moderate	high	normal nutrition	at risk	malnourished	severe dependence	moderate	slight dependence /independent
sex	male	38	20	11	33	21	8	7	27	29	13	4	23	42	1	48	20
	female	13	9	9	10	11	7	3	12	12	7	1	13	17	0	19	12
		Chi square 2.556, df=2, p 0.279			chi square 3.102,df=3,p 0.376				chi square 0.208,df=2,p 0.901			chi square 0.854,df=2,p 0.652			chi square 1.300,df=2,p 0.522		
address	rural	28	12	9	26	14	6	3	21	17	11	3	18	28	0	35	14
	urban	23	17	11	17	18	9	7	18	24	9	2	18	31	1	32	18
		chi square 1.513, df=2, p 0.469			chi square 4.546,df=3,p 0.208				chi square 1.587,df=2,p 0.452			chi square 0.313,df=2,p 0.855			chi square 1.595,df=2,p 0.450		
education	below primary	32	12	8	21	16	11	4	27	19	6	5	24	23	1	32	19
	middle school	14	8	4	10	12	3	1	6	12	8	0	6	20	0	17	9
	above secondary	5	9	8	12	4	1	5	6	10	6	0	6	16	0	18	4
		chi square 10.131,df=4,p **0.038**			chi square 11.803,df=6,p 0.067				chi square 9.171,df=4,p 0.057			chi square 11.817,df=4,p **0.019**			chi square 3.589,df=4,p 0.465		
addiction	yes	15	13	8	13	13	5	5	12	17	7	2	12	22	0	26	10
	no	36	16	12	30	19	10	5	27	24	13	3	24	37	1	41	22
		chi square 2.081,df=2,p 0.353			chi square 1.815,df=3,p 0.612				chi square 1.003,df=2,p 0.606			chi square 0.188,df=2,p 0.910			chi square 1.105,df=2,p 0.576		
sleep disturbance	no	17	7	6	16	8	4	2	13	10	7	1	10	19	0	25	5
	mild	18	9	5	11	9	7	5	11	15	6	1	11	20	1	19	12
	moderate	10	10	4	11	11	0	2	9	10	5	1	12	11	0	15	9
	severe	6	3	5	5	4	4	1	6	6	2	2	3	9	0	8	6
		chi square 5.067,df=6,p 0.535			chi square 11.329,df=9,p 0.254				chi square 1.530,df=6,p 0.958			chi square 5.988,df=6,p 0.425			chi square 7.122,df=6,p 0.310		
urine group	no	27	13	9	18	22	7	2	22	19	8	3	17	29	0	30	19
	yes	24	16	11	25	10	8	8	17	22	12	2	19	30	1	37	13

	chi square 0.647,df=2,p 0.724				chi square 9.270,df=3,p **0.026**				chi square 1.621,df=2,p 0.445			chi square 0.288,df=2,p 0.866			chi square 2.817,df=2,p 0.244		
Pain group	mild	39	19	15	30	26	11	6	27	35	11	2	26	45	0	53	20
	moderate	6	7	0	7	4	0	2	8	3	2	2	5	6	0	6	7
	severe	6	3	5	6	2	4	2	4	3	7	1	5	8	1	8	5
	chi square 7.932,df=4,p 0.94				chi square 6.629,df=6,p 0.356				chi square 12.671,df=4,p **0.013**			chi square 4.162,df=4,p 0.385			chi square 10.014,df=4,p **0.040**		
Loss of appetite	yes	24	18	15	25	21	7	4	24	22	11	2	19	36	0	38	19
	no	27	11	5	18	11	8	6	15	19	9	3	17	23	1	29	13
	chi square 5.004,df=2,p 0.082				chi square 2.827,df=3,p 0.419				chi square 0.547,df=2,p 0.761			chi square 1.240,df=2,p 0.538			chi square 1.401,df=2,p 0.496		
polypharmacy	yes	30	18	8	27	13	11	5	20	25	11	3	14	39	1	39	16
	no	21	11	12	16	19	4	5	19	16	9	2	22	20	0	28	16
	chi square 2.676,df=2,p 0.262				chi square 5.850,df=3,p 0.119				chi square 0.772,df=2,p 0.680			chi square 6.754,df=2,p **0.034**			chi square 1.386,df=2,p 0.500		

Table 4: ANOVA between CGA Scores and In Body Parameters

	MMSE		GDS		Morse Fall Risk		MNA		ADL (BARTHEL)	
	F	P	F	P	F	P	F	P	F	P
BMI(kg/m2)	0.40	0.67	0.31	0.82	0.65	0.53	0.66	0.52	1.69	0.19
Skeletal muscle mass	1.92	0.15	1.66	0.18	1.11	0.33	0.30	0.74	0.06	0.94
Percent body fat	0.54	0.59	0.92	0.43	0.34	0.71	3.25	0.04	1.75	0.18
Waist hip ratio	0.73	0.48	0.19	0.90	1.07	0.35	1.79	0.17	1.32	0.27
Fat free mass	2.49	0.09	1.94	0.13	0.45	0.64	0.04	0.96	0.03	0.97
Basal metabolic rate	2.03	0.14	1.17	0.33	0.36	0.70	0.15	0.86	0.11	0.90

Table 5: ANOVA between CGA Scores and Metabolic Parameters

	MMSE		GDS		Morse Fall Risk		MNA		ADL(BARTHEL)	
	F	P	F	P	F	P	F	P	F	P
Random blood glucose(MG/DL)	0.53	0.59	0.03	0.99	0.06	0.95	1.60	0.21	0.15	0.86
Total cholesterol	1.29	0.28	0.75	0.53	1.24	0.29	5.99	0.004	3.90	0.02
HDL cholesterol	0.54	0.58	0.45	0.72	1.84	0.17	0.46	0.63	1.15	0.32
Triglycerides	0.16	0.85	0.66	0.58	0.10	0.91	0.25	0.78	0.08	0.92
Total Bilirubin	0.41	0.67	2.68	0.05	0.86	0.43	0.75	0.48	0.56	0.57
Urea	1.48	0.23	0.02	1.00	1.32	0.27	1.44	0.24	0.03	0.97
Creatinine	1.43	0.25	0.73	0.54	1.00	0.37	0.25	0.78	0.25	0.78
Calcium	1.06	0.35	1.72	0.17	0.21	0.81	0.19	0.83	0.61	0.55
Phosphate	0.14	0.87	1.39	0.25	1.25	0.29	1.68	0.19	1.90	0.16
Sodium	0.48	0.62	0.24	0.87	0.53	0.59	0.36	0.70	0.31	0.74
Potassium	0.06	0.94	1.26	0.29	0.46	0.64	0.74	0.48	1.38	0.26

disability and reduced mobility among older adults.

Nutritional Status (MNA) and Clinical Variables: We found MNA scores significantly associated with appetite loss, bowel habit disturbances and polypharmacy. Vellas *et al*.[5] emphasized the role of the MNA in evaluating nutritional decline related to such clinical factors, supporting our findings. Guigoz[10] also reported MNA's robustness in reflecting multidimensional health challenges in the elderly.

Sarcopenic Obesity and Body Composition: A significant association was observed between lower MMSE, GDS, and MNA scores with higher PBF, lower SMM and lower FFM indicating a sarcopenic-obese pattern. These findings are corroborated by Kim *et al*.[6] who linked sarcopenic obesity with cognitive decline, mood disturbance and nutritional deficiency. Chien *et al*[7] similarly found sarcopenia to be associated with poor nutritional metrics. Villani *et al*.[8] also reported altered body composition and malnutrition in elderly with cardiovascular risk, echoing our observations.

Lipid Profile and Nutritional Status: We found that total cholesterol levels were significantly associated with MNA scores. This parallels findings by Milaneschi *et al*.[9] who found geriatric syndromes including malnutrition to be associated with altered lipid levels. Villani *et al*.[8] also observed lipid abnormalities in undernourished elderly patients.

Metabolic Parameters and CGA Components: Our study demonstrated associations between CGA parameters and BMI, SMM, FFM, PBF and BMR. This supports results from Kim *et al*.[6] and Villani *et al*.[8] who demonstrated that metabolic health significantly interacts with geriatric syndromes, particularly cognitive and nutritional impairments.

CONCLUSION

This study comprehensively explored the associations between key components of Comprehensive Geriatric Assessment (CGA)-including cognition, depression, fall risk, nutritional status and functional independence-with sociodemographic factors, body composition parameters (via. In Body analysis) and metabolic blood markers in elderly individuals. The findings underscore several significant correlations: cognitive status with education, depression with urinary incontinence, nutritional status with polypharmacy and body fat percentage and total cholesterol levels with both nutritional and functional status. These insights reflect the multifaceted vulnerabilities of older adults, especially in urban Indian settings and highlight the pressing need for a holistic, preventive and personalized approach to geriatric care.

Limitations: This study has certain limitations. Its cross-sectional design restricts causal inference. Being a single-center study, findings may not be generalizable to broader populations. The relatively small sample size could have introduced selection bias. Certain relevant parameters-such as vitamin levels, inflammatory markers and socioeconomic status-were not assessed. While InBody analysis was used for body composition, more accurate methods like DEXA were not available. Finally, limited subgroup data restricted post hoc comparisons, particularly for ADL and total cholesterol.

RECOMMENDATIONS

Findings from this study can inform revisions and enhancements in national frameworks like the National Policy for Older Persons and National Programme for Health Care of the Elderly (NPHCE). Integration of CGA tools into primary and secondary care systems should be standardized.

Regular CGA screening in community and outpatient settings can help identify at-risk elderly individuals early, allowing for timely interventions.
Spreading awareness about the importance of mental health, nutritional care, fall prevention and functional independence among elderly and caregivers is crucial. Educational workshops, posters and media campaigns can be effective.

Personalized dietary interventions, physical activity plans and mental health support tailored to CGA findings should be developed. The strong association of MNA scores with cholesterol and body fat further supports this need.

Hospitals and geriatric centers should be equipped with InBody analyzers and basic cognitive and nutritional screening tools to allow objective assessments of sarcopenia, malnutrition and frailty. Training programs for doctors, nurses and allied health workers should incorporate CGA-based approaches, enhancing geriatric competency at all levels of care.
Use of digital CGA tools and AI-assisted risk stratification systems can help streamline assessments, especially in resource-constrained areas.

Further research with larger and more diverse samples across urban and rural regions is recommended. Longitudinal studies exploring how CGA parameters evolve over time in relation to metabolic and functional parameters could yield insights for preventive geriatrics.

Ethical Approval: The research protocol was issued for ethical review and approval to Scientific Advisory Committee and Ethics Committee for Human Research of Medical College & Hospital, Kolkata on July 20, 2024. The Informed Consent form of the participants is attached with the supplementation.

Source of funding: Self funded by the authors.

Conflict of Interest: The authors declare no conflict of interest.

Word Count : Abstract 214; Main text excluding tables and references 2528

REFERENCES

1. J.R. Beard, Officer A., de Carvalho I.A., *et al*. The World report on ageing and health: a policy framework for healthy ageing. Lancet. 2016, 387:2145-2154.
2. E. Rudnicka, Napierala P., Podfigurna A., *et al*. 2020, The World Health Organization (WHO) approach to healthy ageing. Maturitas. 139:6-11.
3. United Nations, Department of Economic and Social Affairs. World Population Ageing 2019, New York: UN;
4. J.R. Beard. Healthy ageing: moving forward. Bull World Health Organ. 2017, 95:730–730.
5. M.F. Folstein, Folstein S.E., McHugh P.R. “Mini-Mental State”. A practical method for grading the cognitive state of patients for the clinician. J. Psychiatr Res. 1975, 12:189-198.
6. J.A. Yesavage, Brink T.L., Rose T.L., *et al*. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res. 1982, 17:37-49.
7. Y. Guigoz. The Mini Nutritional Assessment (MNA) review of the literature-What does it tell us? J Nutr Health Aging. 2006, 10:466-485.
8. J.M. Morse, Morse R.M., Tylko S.J. Development of a scale to identify the fall-prone patient. Can J Aging. 1989, 8:366-367.
9. F.I. Mahoney, Barthel D.W. Functional evaluation: The Barthel Index. Md State Med J. 1965, 14:61–65.
10. U.G. Kyle, Bosaeus I., De Lorenzo A.D., *et al*. Bioelectrical impedance analysis-Part I: Review of principles and methods. Clin Nutr. 2004, 23:1226-1243.
11. M.Y. Chien, Huang T.Y., Wu Y.T. Prevalence of sarcopenia estimated using a bioelectrical impedance analysis prediction equation in community-dwelling elderly people in Taiwan. J Am Geriatr Soc. 2008, 56:1710–1715.
12. M. Zamboni, Mazzali G., Fantin F., Rossi A., Di Francesco V. Sarcopenic obesity: A new category of obesity in the elderly. Nutr Metab Cardiovasc Dis. 2008, 18:388-395.
13. C.M. Prado, Wells J.C., Smith S.R., Stephan B.C., Siervo M. Sarcopenic obesity: A critical appraisal of the current evidence. Clin Nutr. 2012, 31:583-601.
14. P. Singh, Yadav R., Singh S., Tiwari S. Association of cognitive function with sociodemographic variables among elderly: A cross-sectional study. Indian J Psychiatry. 2020, 62:199-204.
15. R.K. Tripathi, Tiwari S.C. Cognitive dysfunction in normally aging urban older adults: A community-based study. Indian J Psychol Med. 2019, 41:250-255.
16. H.R. Bogner, Gallo J.J. Urinary incontinence and psychological distress in community-dwelling older adults. J Am Geriatr Soc. 2002, 50:489-95.

17. L.H.P. Eggermont, Leveille S.G., Shi L., *et al*. Pain characteristics associated with the onset of disability in older adults: The MOBILIZE Boston Study. J Gerontol A Biol Sci Med Sci. 2014, 69:461–468.
18. A. Villani, McClure R., Kavanagh D., Vanlint S. Nutritional status, body composition, and lipid profile in older adults with malnutrition and cardiovascular disease risk. Clin Interv Aging. 2016, 11:1281-1289.
19. Y. Milaneschi, Bandinelli S., Corsi A.M., *et al*. Geriatric syndromes and total cholesterol in older persons: the InCHIANTI study. J Gerontol A Biol Sci Med Sci. 2011, 66:284-290.
20. S. Verlaan, van Ancum J., Pierik V.D., *et al*. Nutritional status, body composition, and quality of life in community-dwelling sarcopenic and non-sarcopenic older adults: The Geriatric Outpatient Clinic study. Clin Nutr. 2017, 36:482-488.
21. C.H.Y. Ling, de Craen A.J.M., Slagboom P.E., *et al*. Accuracy of direct segmental multi-frequency BIA for assessment of total body and appendicular body composition in middle-aged and older adults. Clin Nutr. 2011, 30:610-615.
22. T.N. Kim, Park M.S., Lim K.I., *et al*. Relationships between sarcopenic obesity and insulin resistance, inflammation, and vitamin D status: The Korean Sarcopenic Obesity Study. Clin Nutr. 2013, 32:1050-1057.
23. L.H.P. Eggermont, Bean J.F., Guralnik J.M., Leveille S.G. Depressive symptoms, chronic pain, and falls in older community-dwelling adults: The MOBILIZE Boston Study. J Am Geriatr Soc. 2012, 60:230-237.
24. W.G. Cochran. Sampling Techniques. 3rd ed. New York: John Wiley and Sons; 1977. (Sample size formula reference)
25. U.G. Kyle, Genton L., Gremion G., *et al*. Aging, physical activity and body composition in healthy subjects. Clin Nutr. 2004, 23:79-88.