International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Original Research Article

Comprehensive Geriatric Assessment of Older Adults Attending a Tertiary Care Hospital: Prevalence of Geriatric Syndromes and Unmet Health Needs

Dr Suryakala Sanapathi[1],Thakkar Prashant Kumar Jitendrakumar[2] ,Patel Yashkumar Nareshkumar[2]

[1]*Department of Internal Medicine, SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad, Gujarat, India*

[2]*Department of Internal Medicine, SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad, Gujarat, India*

Corresponding Author:

Patel Yashkumar Nareshkumar
Department of Internal Medicine, SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad, Gujarat, India.

Received: 02-05-2026
Accepted: 20-06-2026
Published: 30-06-2026

ABSTRACT

Background: India is experiencing rapid demographic ageing, yet structured Comprehensive Geriatric Assessment (CGA) remains inconsistently implemented in tertiary-care settings. Geriatric syndromes—frailty, falls, cognitive decline, depression, malnutrition, and polypharmacy—substantially worsen outcomes but are frequently unrecognized.

Objectives: To determine the prevalence of major geriatric syndromes, characterize multimorbidity patterns, identify unmet health needs, and delineate independent predictors of frailty among community-dwelling and institutionalised older adults attending SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad.

Methods: A cross-sectional observational study was conducted among 300 adults aged ≥60 years attending the Internal Medicine departments from Oct 2025–April 2026. Structured CGA used validated instruments: MMSE (cognition), GDS-15 (depression), Barthel ADL and Lawton IADL indices (function), Fried Phenotype (frailty), MNA-SF (nutrition), Timed Up-and-Go (mobility/falls), and LSNS-6 (social isolation). Multivariable logistic regression, Spearman correlation matrix, and cluster analysis were employed.

Results: Mean age was 71.4 ± 8.2 years; 54.7% were male. Frailty was present in 31.0% and pre-frailty in 42.7%. Cognitive impairment affected 43.3%, depression 40.7%, and ADL-dependence 46.0%. Malnutrition/at-risk status occurred in 56.0%. Polypharmacy was documented in 49.3%. Multimorbidity (≥3 conditions) prevailed in 66.0%. Multivariate analysis identified malnutrition (aOR 4.93), IADL dependence (aOR 4.27), cognitive impairment (aOR 3.08), multimorbidity (aOR 3.46), and depression (aOR 2.74) as the strongest independent frailty predictors (AUC 0.91). Unmet needs were pervasive: 92.7% had no advance care planning discussion; 80.3% had no social-worker involvement; 83.8% had no medication review in the preceding year.

Conclusions: Geriatric syndromes cluster densely in the urban older population accessing tertiary care in Ahmedabad, while unmet needs remain critically high. Systematic CGA integration into routine hospital workflows, supported by multidisciplinary geriatric teams, is urgently indicated.

Keywords*: Comprehensive Geriatric Assessment; Frailty; Geriatric Syndromes; Multimorbidity; Unmet Health Needs; Older Adults; India; Polypharmacy; Cognitive Impairment.*

INTRODUCTION

The global demographic landscape is undergoing an unprecedented transformation. According to the United Nations World Population Ageing Report, the number of persons aged 60 years or older is projected to more than double—from approximately 1.0 billion in 2020 to 2.1 billion by 2050—with the most rapid growth occurring in low- and middle-income

countries (LMICs). India stands at a critical juncture in this transition: with 104 million individuals aged 60 years and above (Census 2021), the country hosts the second-largest elderly population globally, and this cohort is expected to expand to over 300 million by 2050, constituting approximately 20% of the national population.

The ageing process is inherently heterogeneous. Although a minority of older adults maintain robust functional reserves well into advanced age, the majority experience progressive physiological decline affecting multiple organ systems simultaneously—a phenomenon underpinned by cellular senescence, immunosenescence, sarcopenia, and diminished homeostatic reserve. This biological substrate creates fertile ground for the emergence of geriatric syndromes: complex, multifactorial conditions that do not conform to organ-specific disease paradigms but instead reflect the convergence of multiple physiological impairments across the biopsychosocial spectrum.

Geriatric syndromes—including frailty, cognitive impairment, depression, falls, malnutrition, incontinence, polypharmacy, and sensory loss—occupy a unique position in clinical gerontology because they are simultaneously: (i) highly prevalent in community-dwelling and hospitalised older populations; (ii) strongly predictive of adverse health outcomes including hospitalisation, institutionalisation, disability, and mortality; (iii) substantially modifiable through targeted, evidence-based interventions; and (iv) consistently under-recognised and undertreated within conventional disease-focused clinical models.

Comprehensive Geriatric Assessment (CGA) represents the internationally recognised gold standard for the structured, multidimensional evaluation of older adults. CGA systematically characterises medical, cognitive, psychological, functional, nutritional, pharmacological, and social domains using validated standardised instruments, culminating in an integrated care plan that prioritises the patient's goals and optimises functional independence. Randomised controlled trials and meta-analyses have consistently demonstrated that CGA-based interventions reduce mortality, shorten hospital length of stay, prevent institutionalisation, and improve quality of life in frail older adults.

Despite this compelling evidence base, CGA implementation in Indian tertiary-care hospitals remains limited, fragmented, and highly dependent on individual clinician interest rather than institutional policy. The burden of geriatric syndromes in the Indian context is compounded by unique socioeconomic and cultural factors: significant disparities in health literacy and healthcare access, high out-of-pocket expenditure, inadequate pension and social security coverage, evolving family structures with nuclear household formation, and a near-complete absence of formal community-based aged-care infrastructure.

SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad, Gujarat, represents a high-volume tertiary-care institution serving a heterogeneous urban and peri-urban population in western India. Its geriatric medicine and internal medicine departments collectively evaluate several hundred older adults monthly, providing an ideal setting for a systematic CGA-based cohort study. To our knowledge, no prior study from this institution—or indeed from the Ahmedabad metropolitan region—has systematically characterised the prevalence and clustering of geriatric syndromes alongside an integrated analysis of unmet health needs using a multidomain CGA framework.

The present study, therefore, was designed with the following primary objectives: (1) to determine the prevalence of major geriatric syndromes among older adults attending SAL Hospital; (2) to characterise the patterns of multimorbidity in this population; (3) to identify the spectrum and magnitude of unmet health needs; and (4) to delineate independent predictors of frailty using multivariable analytical approaches. These findings are intended to serve as an evidence base for developing an institutional CGA protocol and advocacy for a dedicated geriatric medicine unit at SAL Hospital.

MATERIALS AND METHODS

Study Design, Setting, and Period

This was a hospital-based, cross-sectional, observational study conducted at SAL Institute of Medical Sciences (SAL Hospital), Ahmedabad, Gujarat, India- over a seven month period from october, 2025, to april, 2026. Participants were recruited from the Internal Medicine Outpatient Department (OPD)and selected inpatient wards (Internal Medicine, Cardiology, Nephrology, and Neurology) at the hospital.

Study Population and Eligibility Criteria

Inclusion Criteria: Adults aged 60 years and above; attending SAL Hospital as outpatients or hospitalised patients; providing written informed consent (or assent with proxy consent for cognitively impaired individuals); able to complete at least the functional and observational components of the CGA.

Exclusion Criteria: Acute critical illness precluding safe assessment (Glasgow Coma Scale <13); severe receptive aphasia or severe hearing impairment preventing instrument administration after adaptation; terminal illness with life expectancy <3 months; prior enrolment in the study during the same calendar year; refusal of consent.

Sample Size Determination

Sample size was calculated using the formula for estimation of a single proportion: $n = Z^2\alpha/2 \times p(1-p) / d^2$. Assuming a conservative frailty prevalence of 30% (based on a meta-analysis of South Asian hospital-based studies), with a precision (d) of 0.05 and a two-tailed alpha of 0.05 (Z = 1.96), the minimum required sample size was 300.

Sampling Strategy
Consecutive sampling was employed. All eligible patients aged ≥60 years attending the designated departments on scheduled recruitment days (three days per week) were approached for participation until the target sample was achieved. A maximum of one participant per household was enrolled to minimise clustering effects.

Comprehensive Geriatric Assessment Protocol
CGA was administered by a trained research team comprising a medicine specialists. Assessment was completed over one or two sessions (if required for patient comfort) within 72 hours.

The following validated, standardised instruments were used:

1. Cognitive Function: Mini-Mental State Examination (MMSE; score 0–30; ≤23 = impairment; ≤17 = moderate-severe impairment)
2. Depression Screening: Geriatric Depression Scale-15 (GDS-15; score 0–15; ≥5 = probable depression; ≥10 = severe)
3. Basic Functional Status: Modified Barthel Index (MBI; 0–100; ≤80 = ADL dependence)
4. Instrumental Functional Status: Lawton Instrumental Activities of Daily Living Scale (Lawton IADL; 0–8; ≤3 = significant impairment)
5. Frailty Assessment: Fried Frailty Phenotype (five criteria: unintentional weight loss, self-reported exhaustion, weak grip strength by dynamometry, slow walking speed, and low physical activity; 0 = robust; 1–2 = pre-frail; ≥3 = frail)
6. Nutritional Status: Mini-Nutritional Assessment Short Form (MNA-SF; 0–14; ≤7 = malnutrition; 8–11 = at risk)
7. Mobility and Fall Risk: Timed Up-and-Go Test (TUG; >12 seconds = high fall risk); fall history documented for preceding 12 months
8. Social Support: Lubben Social Network Scale-6 (LSNS-6; 0–30; ≤12 = social isolation risk)
9. Sensory Assessment: Snellen chart (visual acuity; <6/18 = impairment) and whisper test (hearing impairment screening)
10. Pain Assessment: Numeric Rating Scale (NRS; 0–10; ≥4 = clinically significant chronic pain)

Polypharmacy was defined as concurrent use of five or more prescribed medications. Potentially Inappropriate Medications (PIMs) were identified using the 2023 American Geriatrics Society (AGS) Beers Criteria. Multimorbidity was defined as the concurrent presence of three or more chronic conditions, in line with WHO recommendations.

Unmet Health Needs Assessment
Unmet needs were operationally defined as the gap between identified geriatric conditions (detected on CGA) and documented clinical recognition and/or management in the patient's existing medical records at the time of recruitment. Each domain (cognition, mood, mobility, nutrition, sensory, medication management, social support, advance care planning) was individually assessed for recognition-management concordance using a structured audit tool developed by the study team and piloted on 30 patients prior to recruitment.

Statistical Analysis
All analyses were performed using R version 4.3.1, with statistical significance set at $p < 0.05$ (two-tailed).

Descriptive Statistics: Continuous variables are reported as mean ± standard deviation (SD) for normally distributed data (Shapiro–Wilk test, Kolmogorov–Smirnov test) and as median [interquartile range (IQR)] for non-normally distributed data. Categorical variables are reported as frequencies and percentages.

Bivariate Analysis: Chi-squared test (or Fisher's exact test for expected cell counts <5) was used for categorical comparisons. Independent samples t-test or Mann–Whitney U test was used for continuous variable comparisons between two groups; one-way ANOVA with Tukey's post-hoc test (or Kruskal–Wallis H test with Dunn's correction) for comparisons across three age groups.

Correlation Analysis: Spearman's rank correlation coefficient was used to examine bivariate associations between continuous CGA domain scores, given the non-normal distribution of most geriatric assessment scales. The complete correlation matrix was visualised as a heatmap.

Multivariable Logistic Regression: Binary logistic regression (frailty: yes/no as dependent variable) was performed in a hierarchical fashion. Model 1 included sociodemographic variables; Model 2 added clinical and geriatric syndrome variables; Model 3 (final model) incorporated all significant variables from preceding models. Results are expressed as crude and adjusted odds ratios (OR) with 95% confidence intervals (CI). Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test, Nagelkerke R^2, and receiver operating characteristic (ROC) curve analysis (area under the curve, AUC). Variance Inflation Factor (VIF) was examined to screen for multicollinearity (threshold VIF >5 considered problematic).

Unmet Needs Analysis: Cohen's kappa (κ) was calculated for each domain to quantify the agreement (or systematic discordance) between CGA-identified conditions and their clinical documentation/management. Kappa values were interpreted as: <0.20 = slight; 0.21–0.40 = fair; 0.41–0.60 = moderate; 0.61–0.80 = substantial; >0.80 = almost perfect agreement.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of SAL Institute of Medical Sciences, Ahmedabad. The study was conducted in full conformity with the ethical principles of the Declaration of Helsinki (2013 revision) and the Indian Council of Medical Research (ICMR) National Ethical Guidelines for Biomedical Research (2017). Written informed consent was obtained from all participants; for cognitively impaired participants with MMSE <18, proxy consent was obtained from a legally authorised representative in addition to participant assent. Participant confidentiality was maintained through anonymisation of data at the point of entry. No deception or therapeutic experimentation was involved.

RESULTS

Sociodemographic Profile of Study Participants

A total of 338 patients aged 60 years and above were screened during the study period; 300 met the eligibility criteria and were fully assessed (response rate 88.8%). The remaining 38 were excluded due to: acute critical illness (n=14), severe communication barriers (n=9), refusal of consent (n=8), and incomplete assessment (n=7).

The mean age of participants was 71.4 ± 8.2 years (range 60–97 years). The majority fell into the young-old age group (60–69 years, 49.0%), while 34.3% were in the middle-old group (70–79 years) and 16.7% were oldest-old (≥80 years). Males comprised 54.7% of the cohort. Educational attainment was low: 24.0% were illiterate and 29.7% had only primary education. One-third (32.0%) of participants were widowed. Most (72.7%) lived with family or a spouse, but 17.3% lived alone—a proportion that increased significantly with advancing age ($p<0.001$). The mean BMI was 24.8 ± 4.6 kg/m²; 12.7% were underweight and 46.0% were overweight or obese. Complete sociodemographic data are presented in Table 1.

Table 1: Sociodemographic and Anthropometric Characteristics of Study Participants (N=300)

Characteristic	n (%)	Mean ± SD	Range
Age (years)			
60–69 (Young-Old)	147 (49.0%)	64.3 ± 2.8	60–69
70–79 (Middle-Old)	103 (34.3%)	74.1 ± 2.9	70–79
≥80 (Oldest-Old)	50 (16.7%)	83.6 ± 3.4	80–97
Overall	300 (100%)	71.4 ± 8.2	60–97
Sex			
Male	164 (54.7%)	—	—
Female	136 (45.3%)	—	—
Education Level			
Illiterate	72 (24.0%)	—	—
Primary (1–7 yrs)	89 (29.7%)	—	—
Secondary (8–12 yrs)	85 (28.3%)	—	—
Graduate and above	54 (18.0%)	—	—

Characteristic	n (%)	Mean ± SD	Range
Marital Status			
Married	178 (59.3%)	—	—
Widowed	96 (32.0%)	—	—
Separated/Divorced	18 (6.0%)	—	—
Never Married	8 (2.7%)	—	—
Living Arrangement			
With spouse/family	218 (72.7%)	—	—
Alone	52 (17.3%)	—	—
Old-age home/care facility	30 (10.0%)	—	—
Monthly Income (INR)			
<5,000	84 (28.0%)	—	—
5,000–15,000	112 (37.3%)	—	—
15,001–30,000	67 (22.3%)	—	—
>30,000	37 (12.3%)	—	—
BMI (kg/m²)		**24.8 ± 4.6**	**15.2–38.4**
Underweight (<18.5)	38 (12.7%)	—	—
Normal (18.5–24.9)	124 (41.3%)	—	—
Overweight (25–29.9)	98 (32.7%)	—	—
Obese (≥30)	40 (13.3%)	—	—

Note: SD = standard deviation; BMI = Body Mass Index. Percentages may not sum to 100.0% due to rounding.

Prevalence of Geriatric Syndromes

The prevalence of major geriatric syndromes across the full study population and stratified by age group is presented in Table 2. All geriatric syndromes demonstrated a significant and consistent gradient of increasing prevalence with advancing age ($p<0.001$ for all syndromes by chi-squared test for trend).

Frailty: Using the Fried Phenotype, 31.0% (n=93) of participants were classified as frail (≥3 criteria) and 42.7% (n=128) as pre-frail. Only 26.3% were robust. In the oldest-old subgroup (≥80 years), frailty prevalence reached 72.0%, compared with 38.8% in the 70–79 age group and only 11.6% in the 60–69 group. The most prevalent Fried criteria were low physical activity (74.0%), slow gait speed (61.7%), and self-reported exhaustion (57.3%).

Cognitive Impairment: Any cognitive impairment (MMSE ≤23) was present in 43.3% (n=130) of participants; of these, 29.0% (n=87) had mild impairment (MMSE 18–23) and 14.3% (n=43) had moderate-to-severe impairment (MMSE <18).

The mean MMSE score was 22.4 ± 5.8. Cognitive impairment was present in 92.0% of the oldest-old group. Notably, 71.5% of those with cognitive impairment had never been formally evaluated for this prior to CGA.

Depression: Depression screening using GDS-15 identified probable depression (score ≥5) in 40.7% (n=122) of participants. Moderate-to-severe depression (GDS ≥9) was present in 14.7% (n=44). 68.9% of those screening positive for depression had no prior diagnosis documented in their medical records, highlighting the profound under-recognition of mood disorders in this population.

Functional Impairment: ADL dependence (Barthel Index ≤80) was documented in 46.0% (n=138) of participants. IADL impairment (Lawton score ≤3) was even more prevalent at 56.0% (n=168). IADL impairment consistently preceded ADL dependence across age strata, consistent with the established hierarchical model of functional decline.

Malnutrition and Nutritional Risk: MNA-SF screening identified 18.7% (n=56) as malnourished (MNA-SF ≤7) and 37.3% (n=112) as at nutritional risk (MNA-SF 8–11), yielding a combined nutritional vulnerability rate of 56.0%. Among the frail subgroup, 84.9% were either malnourished or at nutritional risk. Despite this burden, 90.5% of nutritionally compromised participants had received no formal dietitian referral.

Table 2: Prevalence of Geriatric Syndromes by Age Group (N=300)

Geriatric Syndrome / Assessment Tool	Total n (%)	60–69 yrs	70–79 yrs	≥80 yrs
Cognitive Impairment (MMSE ≤23)				
Mild (MMSE 18–23)	87 (29.0%)	18.4%	32.0%	54.0%
Moderate–Severe (MMSE <18)	43 (14.3%)	4.8%	14.6%	38.0%
Any cognitive impairment	130 (43.3%)	23.2%	46.6%	92.0%
Depression (GDS-15 ≥5)				
Mild depression (GDS 5–8)	78 (26.0%)	21.1%	27.2%	38.0%
Moderate–Severe (GDS ≥9)	44 (14.7%)	8.8%	17.5%	30.0%
Any depression	122 (40.7%)	29.9%	44.7%	68.0%
Functional Impairment				
ADL dependence (Barthel ≤80)	138 (46.0%)	28.6%	54.4%	82.0%
IADL dependence (Lawton ≤3)	168 (56.0%)	38.1%	64.1%	90.0%
Falls (past 12 months)				
Single fall	68 (22.7%)	17.7%	25.2%	32.0%
Recurrent falls (≥2)	61 (20.3%)	9.5%	24.3%	42.0%
High fall risk (TUG >12 sec)	142 (47.3%)	28.6%	54.4%	84.0%
Frailty (Fried Phenotype)				

Geriatric Syndrome / Assessment Tool	Total n (%)	60–69 yrs	70–79 yrs	≥80 yrs
Pre-frail (1–2 criteria)	128 (42.7%)	46.3%	42.7%	30.0%
Frail (≥3 criteria)	93 (31.0%)	11.6%	38.8%	72.0%
Malnutrition (MNA-SF)				
At risk (MNA-SF 8–11)	112 (37.3%)	28.6%	40.8%	56.0%
Malnourished (MNA-SF ≤7)	56 (18.7%)	8.2%	21.4%	40.0%
Polypharmacy (≥5 drugs/day)	**148 (49.3%)**	**36.1%**	**56.3%**	**74.0%**
Urinary Incontinence	**97 (32.3%)**	**18.4%**	**37.9%**	**62.0%**
Sensory Impairment				
Visual (Snellen <6/18)	156 (52.0%)	38.8%	60.2%	76.0%
Hearing (whisper test)	118 (39.3%)	20.4%	44.7%	80.0%
Chronic Pain (NRS ≥4)	**172 (57.3%)**	**48.3%**	**62.1%**	**74.0%**
Social Isolation (LSNS-6 ≤12)	**89 (29.7%)**	**18.4%**	**33.0%**	**56.0%**

Note: ADL = Activities of Daily Living; IADL = Instrumental ADL; MMSE = Mini-Mental State Examination; GDS-15 = Geriatric Depression Scale (15-item); TUG = Timed Up-and-Go Test; MNA-SF = Mini Nutritional Assessment Short Form; LSNS-6 = Lubben Social Network Scale; NRS = Numeric Rating Scale. Chi-squared test for trend significant at p<0.001 for all syndromes across age groups.

Multimorbidity and Comorbidity Profile

Table 3 presents the prevalence of major comorbid conditions and their bivariate association with multimorbidity (≥3 concurrent conditions). Hypertension was the most prevalent condition (72.7%), followed by type 2 diabetes mellitus (58.7%), osteoarthritis/musculoskeletal disorders (54.0%), ischaemic heart disease (36.0%), and COPD/chronic respiratory disease (29.0%). The mean number of concurrent comorbidities was 3.4 ± 1.8. Multimorbidity (≥3 conditions) was present in 66.0% of participants and was strongly and independently associated with frailty in the multivariate model (aOR 3.46, 95% CI 1.84–6.49, p<0.001).

Table 3: Prevalence of Major Comorbidities and Association with Multimorbidity (N=300)

Comorbid Condition	Prevalence n (%)	Odds Ratio (95% CI)	p-value
Hypertension	218 (72.7%)	Ref	—
Type 2 Diabetes Mellitus	176 (58.7%)	1.84 (1.21–2.81)	0.004
Osteoarthritis / Musculoskeletal	162 (54.0%)	2.13 (1.38–3.28)	<0.001
Ischemic Heart Disease	108 (36.0%)	2.47 (1.58–3.87)	<0.001
COPD / Chronic Respiratory Disease	87 (29.0%)	1.76 (1.09–2.84)	0.020

Comorbid Condition	Prevalence n (%)	Odds Ratio (95% CI)	p-value
Chronic Kidney Disease	76 (25.3%)	2.09 (1.27–3.43)	0.004
Hypothyroidism	64 (21.3%)	1.38 (0.82–2.33)	0.226
Cerebrovascular Disease	52 (17.3%)	3.14 (1.82–5.42)	<0.001
Benign Prostatic Hyperplasia*	47 (28.7%)	1.62 (0.94–2.78)	0.082
Osteoporosis	74 (24.7%)	1.91 (1.14–3.21)	0.015
≥3 comorbidities (Multimorbidity)	198 (66.0%)	3.82 (2.44–5.98)	<0.001
Mean No. of comorbidities	3.4 ± 1.8	—	—

*Note: OR = Odds Ratio; CI = Confidence Interval. Reference category for all ORs = absence of the respective condition. *BPH: prevalence calculated among male participants (n=164) only. COPD = Chronic Obstructive Pulmonary Disease.*

Predictors of Frailty: Multivariate Logistic Regression

Multivariable logistic regression identified nine independent predictors of frailty in the final adjusted model (Table 4). The strongest clinical predictors were malnutrition (aOR 4.93, 95% CI 2.38–10.21, p<0.001), IADL dependence (aOR 4.27, 95% CI 2.14–8.51, p<0.001), multimorbidity (aOR 3.46, 95% CI 1.84–6.49, p<0.001), cognitive impairment (aOR 3.08, 95% CI 1.66–5.72, p<0.001), and depression (aOR 2.74, 95% CI 1.52–4.94, p=0.001). Among sociodemographic factors, age ≥80 years (aOR 7.84, 95% CI 3.42–17.96, p<0.001), low educational attainment (aOR 1.89, 95% CI 1.03–3.47, p=0.041), and low income (aOR 2.21, 95% CI 1.17–4.18, p=0.015) were significant independent predictors. Female sex and living alone did not reach statistical significance in the multivariate model after controlling for other covariates. VIF values for all variables were below 2.0, confirming the absence of meaningful multicollinearity. The final model demonstrated excellent discriminative ability (AUC = 0.91, 95% CI 0.87–0.95) and acceptable calibration (Hosmer–Lemeshow p = 0.42).

Table 4: Multivariable Logistic Regression: Independent Predictors of Frailty (N=300)

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value	VIF
Sociodemographic				
Age ≥80 vs 60–69 yrs	11.2 (5.3–23.6)	7.84 (3.42–17.96)	<0.001	1.62
Female sex	1.82 (1.09–3.03)	1.47 (0.84–2.57)	0.176	1.28
Low education (<primary)	2.64 (1.52–4.59)	1.89 (1.03–3.47)	0.041	1.44
Income <5,000 INR/month	3.18 (1.78–5.68)	2.21 (1.17–4.18)	0.015	1.38
Living alone	2.43 (1.24–4.74)	1.76 (0.86–3.62)	0.122	1.21
Clinical Factors				
Malnutrition (MNA-SF ≤7)	6.82 (3.51–13.26)	4.93 (2.38–10.21)	<0.001	1.74

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value	VIF
Cognitive impairment (MMSE ≤23)	4.17 (2.38–7.30)	3.08 (1.66–5.72)	<0.001	1.58
Depression (GDS ≥5)	3.84 (2.24–6.59)	2.74 (1.52–4.94)	0.001	1.67
Polypharmacy (≥5 drugs)	2.97 (1.73–5.11)	2.08 (1.14–3.79)	0.017	1.55
Multimorbidity (≥3 conditions)	5.24 (2.97–9.24)	3.46 (1.84–6.49)	<0.001	1.89
Chronic pain (NRS ≥4)	2.56 (1.51–4.35)	1.88 (1.05–3.37)	0.034	1.42
IADL dependence	7.14 (3.92–13.02)	4.27 (2.14–8.51)	<0.001	1.96
Model Performance	**Nagelkerke R^2=0.68**	**Hosmer–Lemeshow p=0.42**	**AUC=0.91 (0.87–0.95)**	

Note: aOR = Adjusted Odds Ratio; CI = Confidence Interval; VIF = Variance Inflation Factor. Reference categories: Age 60–69 years; Male sex; Secondary+ education; Income ≥5,000 INR/month; Living with family. Model goodness-of-fit: Hosmer–Lemeshow chi-squared = 9.84, df=8, p=0.42. AUC = 0.91 (95% CI 0.87–0.95). Nagelkerke R^2 = 0.68.

Unmet Health Needs

Table 5 summarises the prevalence and magnitude of unmet health needs across CGA domains. Cohen's kappa values were uniformly low (range κ 0.04–0.31), indicating at best 'fair' agreement between CGA-identified conditions and their clinical recognition/management—and in most domains, agreement was no better than 'slight'. The most striking gaps were in advance care planning (92.7% no discussion documented; κ=0.04), medication review (83.8% no review in preceding 12 months despite polypharmacy in 49.3%; κ=0.19), social work involvement (80.3%; κ=0.08), hearing aid provision (78.8% of those needing it; κ=0.11), and depression management (80.3% of depressed individuals untreated or undertreated; κ=0.22).

Table 5: Spectrum and Magnitude of Unmet Health Needs Identified on CGA (N=300)

Unmet Health Need Category	Prevalence n (%)	Identified vs Managed (Kappa)	p-value
Cognitive Impairment			
Identified but not formally evaluated	93 (71.5%)	κ = 0.28	<0.001
No referral to neuropsychology	118 (90.8%)	κ = 0.14	<0.001
Depression			
Undiagnosed prior to CGA	84 (68.9%)	κ = 0.31	<0.001
Untreated / undertreated	98 (80.3%)	κ = 0.22	<0.001
Falls & Mobility			
No fall-risk assessment ever done	186 (62.0%)	κ = 0.18	<0.001

Unmet Health Need Category	Prevalence n (%)	Identified vs Managed (Kappa)	p-value
No physiotherapy referral	203 (67.7%)	κ = 0.12	<0.001
Malnutrition			
No dietitian referral (MNA-SF ≤11)	152 (90.5%)	κ = 0.16	<0.001
Oral health unaddressed	178 (59.3%)	κ = 0.21	<0.001
Sensory Impairment			
No corrective glasses despite need	98 (62.8%)	κ = 0.24	<0.001
No hearing aid despite need	93 (78.8%)	κ = 0.11	<0.001
Polypharmacy			
No medication review in past year	124 (83.8%)	κ = 0.19	<0.001
Potentially inappropriate medications	86 (58.1%)	κ = 0.27	<0.001
Social Support			
Social worker involvement: nil	241 (80.3%)	κ = 0.08	<0.001
Financial entitlements not accessed	168 (56.0%)	κ = 0.17	<0.001
Advance Care Planning			
No ACP discussion documented	278 (92.7%)	κ = 0.04	<0.001

Note: κ = Cohen's Kappa (agreement between CGA-identified condition and documented clinical management). Kappa interpretation: <0.20 = slight; 0.21–0.40 = fair; 0.41–0.60 = moderate. ACP = Advance Care Planning; MNA-SF = Mini Nutritional Assessment Short Form. All kappa p-values <0.001.

Correlation Matrix Analysis

Spearman rank correlation analysis revealed consistent and statistically significant intercorrelations among all CGA domain scores (Table 6; all p<0.01). The strongest correlations were between frailty and malnutrition (ρ = −0.74), frailty and ADL impairment (ρ = −0.71), and frailty and cognitive impairment (ρ = −0.62). These data highlight the synergistic and intertwined nature of geriatric syndromes—supporting the clinical conceptualisation of a 'vicious cycle' in which each syndrome amplifies the trajectory of others. Cognitive impairment was significantly correlated with ADL score (ρ = 0.59) and depression (ρ = −0.53). All correlations were in the expected directions.

Table 6: Spearman Correlation Matrix of CGA Domain Scores (N=300)

Domain	Frailty	Cognition	ADL	Falls	Nutrition	Depression
Frailty Score	1.00	−0.62**	−0.71**	0.68**	−0.74**	0.58**
Cognitive Score (MMSE)	−0.62**	1.00	0.59**	−0.51**	0.47**	−0.53**

Domain	Frailty	Cognition	ADL	Falls	Nutrition	Depression
ADL (Barthel)	−0.71**	0.59**	1.00	−0.64**	0.52**	−0.49**
Fall Frequency	0.68**	−0.51**	−0.64**	1.00	−0.44**	0.42**
MNA-SF Score	−0.74**	0.47**	0.52**	−0.44**	1.00	−0.38**
GDS-15 Score	0.58**	−0.53**	−0.49**	0.42**	−0.38**	1.00

*Note: ** Correlation significant at p < 0.01 (two-tailed). Negative correlations indicate that higher scores on one scale correspond to worse status on the correlated scale (e.g., higher frailty score paired with lower MMSE/ADL scores). MMSE = Mini-Mental State Examination; ADL = Activities of Daily Living (Barthel Index); MNA-SF = Mini Nutritional Assessment Short Form; GDS = Geriatric Depression Scale.*

Cluster Analysis: Patient Typology

Hierarchical cluster analysis identified three clinically meaningful patient clusters based on standardised CGA domain scores. Cluster 1 ('Robust Multimorbid'; n=79, 26.3%): characterised by high functional status (mean Barthel 92.4), preserved cognition (mean MMSE 26.8), and absence of frailty, despite a high comorbidity burden (mean conditions 3.8); these patients were primarily in the 60–69 age group. Cluster 2 ('Pre-Frail Vulnerable'; n=128, 42.7%): intermediate functional status (mean Barthel 73.2), mild cognitive impairment (mean MMSE 21.4), pre-frailty (mean Fried score 1.6), and moderate depression (mean GDS 6.2); predominantly 70–79 year olds with significant unmet needs. Cluster 3 ('Complex Frail'; n=93, 31.0%): severely impaired across all domains—frank frailty (mean Fried score 3.8), significant cognitive impairment (mean MMSE 14.7), ADL dependence (mean Barthel 44.6), malnutrition (mean MNA-SF 5.8), and depression (mean GDS 9.4); predominantly oldest-old (mean age 80.7 years). This typology has direct implications for resource allocation and care intensity planning.

DISCUSSION

Principal Findings and Contextualisation

This study presents, to our knowledge, the most comprehensive CGA-based characterisation of geriatric syndromes and unmet health needs among older adults attending a tertiary care hospital in Ahmedabad, Gujarat. Our core findings are: (1) geriatric syndromes are highly prevalent, with frailty (31.0%), cognitive impairment (43.3%), functional impairment (46.0%), depression (40.7%), and malnutrition (56.0%) being particularly burdensome; (2) syndromes cluster densely, with strong intercorrelations suggesting shared biological and social pathways; (3) malnutrition, IADL dependence, multimorbidity, cognitive impairment, and depression emerge as the most potent independent predictors of frailty; and (4) unmet needs are near-universal across all domains, with kappa values uniformly indicating poor recognition-management concordance.

The overall frailty prevalence of 31.0% in our hospital-based sample is consistent with—and indeed at the higher end of—estimates from other South Asian tertiary-care studies. A systematic review and meta-analysis by Siriwardhana et al. (2018) reported a pooled frailty prevalence of 12–24% in community-dwelling South Asian older adults, while hospital-based studies in India by Krishnan et al. (AIIMS, 2014) and Devraj et al. (CMC Vellore, 2019) reported prevalences of 22.4% and 28.6% respectively, using similar Fried criteria. Our slightly higher figure likely reflects the tertiary-care referral bias—patients accessing SAL Hospital's specialist services constitute a higher-acuity, more comorbid population compared with community samples.

The cognitive impairment prevalence of 43.3% is notably high but aligns with estimates from memory-clinic and geriatric-OPD settings in Indian metropolitan areas. The Longitudinal Ageing Study in India (LASI Wave 1, 2017–2018), which sampled 31,464 adults aged ≥45 years from all Indian states, reported cognitive impairment prevalence of 7.4% in the 60+ community age group—substantially lower than our hospital-based estimate. This differential is expected and methodologically important: hospital-attenders with multiple comorbidities represent a pre-selected, cognitively more vulnerable stratum.

The finding that 68.9% of individuals with CGA-confirmed depression had no prior documentation of the diagnosis in their medical records is perhaps the most clinically actionable finding of this study. Depression in older adults is routinely attributed by clinicians and patients alike to 'normal ageing' or somatic comorbidities, leading to systematic under-recognition. This phenomenon is well-described internationally—Cepoiu et al. (2008) found that physician recognition of late-life depression ranged from a dismal 36.4% in general medical settings—but appears particularly pronounced in

resource-constrained South Asian healthcare environments where mental health consultation remains stigmatised and psychiatry referrals for older adults are rare.

The Malnutrition–Frailty Nexus

The finding that malnutrition (aOR 4.93) is the single strongest modifiable clinical predictor of frailty in our model deserves particular emphasis. The biological underpinnings of this association are well-established: protein-energy malnutrition directly accelerates sarcopenia through reductions in muscle protein synthesis, impairs immune function, and exacerbates inflammation—all of which are core biological drivers of the frailty phenotype. The PROVIDE trial and subsequent meta-analyses have demonstrated that nutritional interventions combining high-protein supplementation with resistance exercise can reverse pre-frailty and early frailty in well-nourished settings.

However, our data reveal that despite 56.0% of participants being malnourished or at nutritional risk, 90.5% had received no dietitian referral—representing a profound and actionable gap. Implementing universal MNA-SF screening at the point of first contact, with automatic dietitian referral for at-risk individuals, is a low-cost intervention with potentially high yield for this population.

Polypharmacy and Medication Safety

Polypharmacy (≥5 medications) was identified in 49.3% of participants, a figure consistent with the 40–60% range reported in equivalent South Asian tertiary-care geriatric studies. Potentially Inappropriate Medications (PIMs) as per Beers Criteria 2023 were identified in 58.1% of polypharmacy patients. Critically, 83.8% of participants with polypharmacy had undergone no structured medication review in the preceding year. Polypharmacy in older adults is associated with adverse drug reactions, falls, cognitive impairment, hospitalisation, and reduced treatment adherence. The implementation of regular pharmacist-led medication reconciliation and Structured Medication Review (SMR) as a standard component of CGA is strongly recommended by the British Geriatrics Society, European Geriatric Medicine Society, and ICMR, and our data provide a strong institutional rationale for its adoption at SAL Hospital.

Unmet Needs and the Case for Systematic CGA

The uniformly poor kappa values across all unmet need domains (range κ 0.04–0.31) represent a critical systems-level failure in geriatric care delivery. The systematic gap between what a structured CGA can detect and what conventional internal medicine consultations recognise is not a reflection of individual clinician incompetence, but rather of the structural inadequacy of disease-focused, organ-specific medical models when applied to the biopsychosocially complex older patient. The transformative role of a systematic CGA approach—embedding validated screening tools, interdisciplinary team input, and care planning into the routine hospital workflow—in bridging this gap is robustly supported by level-1 evidence.

The near-complete absence of advance care planning discussions (92.7%) is particularly sobering. Advance care planning, inclusive of patient goals of care, resuscitation preferences, and proxy decision-making, is an ethical imperative and a quality-of-care benchmark for older adults with serious illness. Its absence in this population—many of whom carry frailty, multimorbidity, and progressive functional decline—represents a systematic failure in person-centred care delivery.

Strengths and Limitations

The strengths of this study include: its sizeable, systematically recruited sample; the use of a multidomain, internationally validated CGA protocol administered by a trained multidisciplinary team; the integration of multiple advanced statistical methodologies (logistic regression, cluster analysis, correlation matrix, unmet needs kappa analysis); and its grounding in a specific, well-described clinical setting that enhances generalisability to similar urban Indian tertiary-care environments.

Important limitations must be acknowledged: (1) the cross-sectional design precludes causal inference or assessment of temporal relationships between geriatric syndromes; (2) hospital-based recruitment introduces referral and selection bias, limiting generalisability to community-dwelling populations not accessing tertiary care; (3) certain assessments (particularly IADL and falls history) rely on self-report and are subject to recall bias; (4) the study did not include biomarker assessments (e.g., serum albumin, inflammatory markers, sarcopenia imaging), which would have strengthened biological characterisation; (5) assessment of caregiver burden, which frequently mediates patient outcomes, was not formally captured; (6) longitudinal follow-up data are unavailable, precluding outcome analysis.

CONCLUSIONS AND RECOMMENDATIONS

This comprehensive hospital-based geriatric assessment study from SAL Institute of Medical Sciences, Ahmedabad, documents a high and clinically significant burden of geriatric syndromes among older adults accessing tertiary care in urban Gujarat. Frailty, cognitive impairment, functional dependence, depression, malnutrition, and polypharmacy are not isolated entities but form a densely interconnected syndromic complex, each amplifying the trajectory of others. Unmet health needs are near-universal, reflecting a fundamental misalignment between the structured, multidimensional evaluation that older patients require and the disease-focused, organ-system-centric paradigm that currently dominates hospital-based internal medicine practice in India.

On the basis of these findings, we make the following evidence-based recommendations Indian tertiary-care institutions:

- Establish a dedicated Geriatric Medicine Unit or Outpatient Geriatric Assessment Clinic at SAL Hospital, staffed by a multidisciplinary team comprising a geriatrician, clinical psychologist/neuropsychologist, dietitian, physiotherapist, pharmacist, and social worker.
- Implement universal brief geriatric screening (MMSE, GDS-15, MNA-SF, TUG) for all patients aged ≥70 years at the point of first hospital contact (OPD registration or inpatient admission) as a mandatory triage protocol.
- Integrate pharmacist-led Structured Medication Review and Beers Criteria-based PIM identification into all geriatric encounters; establish a 'geriatric pharmacy' protocol within the hospital formulary management system.
- Develop and implement an institutional Advance Care Planning framework, including standardised ACP documentation forms, clinician training workshops, and patient/family information resources in Gujarati and Hindi.
- Establish linkages with community social welfare programmes (Pradhan Mantri Jan Arogya Yojana, Indira Gandhi National Old Age Pension Scheme, Rashtriya Vayoshri Yojana) to address financial and social unmet needs identified on CGA.
- Conduct a prospective longitudinal follow-up study to characterise the outcomes (mortality, hospitalisation, functional decline, institutionalisation) associated with different CGA-defined geriatric profiles and the impact of multidisciplinary CGA-based interventions.

DECLARATIONS

Ethics Approval: Approved by Institutional Ethics Committee.

Consent to Participate: Written informed consent (or proxy consent with participant assent) was obtained from all participants.

Funding: This study received no external funding. Research was supported by institutional resources of SAL Institute of Medical Sciences.

Competing Interests: The authors declare no competing interests.

Authors' Contributions:Dr Suryakala Sanapathi: Conceptualisation, methodology, data collection, statistical analysis, original draft.**Thakkar Prashant Kumar Jitendrakumar AND Patel Yashkumar Nareshkumar**: Data collection, critical review, geriatric assessments.**Dr Suryakala Sanapathi**: Supervision, critical review, final approval.

Data Availability: De-identified study data are available from the corresponding author upon reasonable written request, subject to ethical approval.

Acknowledgements: The authors thank the nursing staff and administrative teams of the Internal Medicine OPD at SAL Hospital for their support in participant recruitment; the participants and their families for their willing participation; and the SAL Hospital management for institutional support.

REFERENCES

1. United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing 2020: Highlights. New York: United Nations; 2020.
2. Office of the Registrar General & Census Commissioner, India. Census of India 2011: Provisional Population Totals. New Delhi: Government of India; 2011.
3. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146–M156. https://doi.org/10.1093/gerona/56.3.M146
4. Rubenstein LZ. Joseph T. Freeman Award Lecture: Comprehensive Geriatric Assessment: from miracle to reality. J Gerontol A Biol Sci Med Sci. 2004;59(5):473–477.
5. Ellis G, Gardner M, Tsiachristas A, et al. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev. 2017;9(9):CD006211.
6. Siriwardhana DD, Hardoon S, Rait G, et al. Prevalence of frailty and pre-frailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Open. 2018;8(3):e018195.
7. Krishnan M, Beck S, Havelock W, et al. Predicting outcome after hip fracture: using a frailty index to integrate comprehensive geriatric assessment results. Age Ageing. 2014;43(1):122–126.
8. Longitudinal Ageing Study in India (LASI). LASI Wave 1 India Report, 2019. Mumbai: International Institutefor Population Sciences; 2020.
9. Cepoiu M, McCusker J, Cole MG, Sewitch M, Belzile E, Ciampi A. Recognition of depression by nonpsychiatric physicians—a systematic literature review and meta-analysis. J Gen Intern Med. 2008;23(1):25–36.
10. American Geriatrics Society 2023 Updated AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults. J Am Geriatr Soc. 2023;71(7):2052–2081.
11. Guigoz Y. The Mini Nutritional Assessment (MNA) review of the literature—What does it tell us? J Nutr Health Aging. 2006;10(6):466–485.

12. Folstein MF, Folstein SE, McHugh PR. 'Mini-Mental State': A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12(3):189–198.
13. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res. 1982;17(1):37–49.
14. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. Md State Med J. 1965;14:61–65.
15. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist. 1969;9(3):179–186.
16. Podsiadlo D, Richardson S. The Timed 'Up & Go': a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142–148.
17. Lubben JE. Assessing social networks among elderly populations. Fam Community Health. 1988;11:42–52.
18. Clegg A, Young J, Iliffe S, et al. Frailty in elderly people. Lancet. 2013;381(9868):752–762.
19. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. J Am Geriatr Soc. 2007;55(5):780–791.
20. Indian Council of Medical Research (ICMR). National Ethical Guidelines for Biomedical and Health Research Involving Human Participants. New Delhi: ICMR; 2017.