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INDIAN JOURNAL OF GERIATRIC CARE

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HIGHLIGHTS


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in older adults
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+ MUSCLES
+ BONES
Horlicks
Vanilla flavour
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BONE STRENGTH
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IJGC
INDIAN JOURNAL OF GERIATRIC CARE

Editorial

Sajesh Asokan
Immediate Past President, Geriatric Society of India and Executive Editor

Geriatric Care in India: Integrating Science, Sensitivity, and Systems

The evolving landscape of geriatric medicine in India calls for approaches that are both scientifically rigorous and sensitive to the lived realities of older adults. This issue of the Indian Journal of Geriatric Medicine brings together a diverse collection of articles that reflect these priorities, spanning functional health, chronic disease management, preventive strategies, emerging biological insights, and clinical challenges.

The opening study provides a comparative analysis of functional ability among older women living in old age homes in Northeast India, highlighting how social context and environment shape independence in later life.

Chronic disease management is explored through the clinical dilemma of whether prolonged Type 2 diabetes mellitus can be controlled with oral hypoglycaemic agents alone.

A dedicated review on Comprehensive Geriatric Assessment (CGA) further emphasizes the importance of multidimensional evaluation in tailoring care to the individual needs of the elderly.

Preventive and supportive strategies find expression in the article on multisensory integration for fall prevention, which expands our understanding of rehabilitation beyond traditional balance training, and in the systematic review on nature therapy, which reaffirms the healing potential of natural environments.

The review on human microbiome variations and dysbiosis in the aged Indian population introduces an exciting frontier in geriatric science, with implications for nutrition, immunity, and healthy ageing.

Respiratory health—one of the most pressing challenges in clinical geriatrics—is addressed through practical insights into the management of respiratory diseases in older adults.

The issue concludes with instructive case reports that underscore the complexity of geriatric practice: an enigmatic fever of unknown origin, nephrotic syndrome due to focal segmental glomerulosclerosis, and a rare neurological complication of chikungunya fever. Each case exemplifies the diagnostic vigilance required when caring for the elderly.

Together, these contributions offer a broad yet cohesive picture of the challenges and opportunities within geriatric medicine. They reinforce the need for a holistic, multidisciplinary, and context-specific approach to elder care in India—an approach that addresses not only disease, but also function, prevention, and quality of life.

Comparative Analysis of Functional Ability among Older Women Living in Two Old Age Homes of Northeast India: A Cross-Sectional Study

Rajkumar Powdel[1]

Abstract

Objective: *To compare the functional ability of older women residing in two old age homes in Northeast India through measurements of physical functioning, cognitive status, and mental well-being using standardized performance-based assessments.*

Design: *A cross-sectional comparative observational study was conducted.*

Methods: *Seventy-eight older women residents from two institutions were assessed: 46 from Apnaghar Old Age Home, Agartala (Tripura) and 32 from Ima Leimarel Women Welfare Association, Imphal (Manipur). Functional capacity was measured using the Short Physical Performance Battery (SPPB), grip strength was assessed with Camry EH101 Dynamometer, cognition was evaluated through Mini-Cog™, and psychological well-being was determined using the WHO-5 Well-being Index. Data normality was determined through Shapiro-Wilk tests and appropriate parametric (independent t-tests) or non-parametric (Mann-Whitney U) statistical analyses. Demographic characteristics, social support patterns, and institutional activity participation were examined.*

Results: *Despite improved sociodemographic status being observed in Imphal residents, including higher literacy rates (15.21% vs 9.52%), greater voluntary admissions (76.08% vs 64.29%), and increased family visitation (56.51% vs 42.86%), superior functional outcomes were demonstrated by Agartala residents across all measures. Significantly better performance was exhibited by Agartala participants compared to Imphal counterparts in physical function (SPPB: 8.217±0.917 vs. 7.625±1.032, p=0.006, Cohen's d = 0.611), cognitive function (Mini-Cog™: 3.239±0.874 vs. 2.875±0.937, p=0.037, Cohen's d=0.400), psychological well-being (WHO-5: 67.91±10.98 vs. 61.43±11.76, p=0.013, Cohen's d=0.567), and handgrip strength (13.998±1.891 vs. 12.765±1.947 kg, p=0.004, Cohen's d=0.640).*

Conclusion: *The findings demonstrated that highly structured and challenging activities predicted better maintenance of functional capacities than passive social support, emphasizing the critical importance of comprehensive physical, mental, and psychological stimulation programs in institutional care settings for preserving independence and overall well-being among older women.*

Keywords: *older women, old-age homes, functional capacities, physical performance, cognitive function, psychological well-being, northeast India*

INTRODUCTION

Progressive decline in physical, mental, and psychosocial functioning has been linked to age, with significant implications for quality of life among older individuals.[1] Age has diminished mobility, balance, and muscle maintenance, with increased risk for falls and activities of daily living loss. [2] At the same time, executive functions such as memory, speed of processing, and executive function have been found to show patterns of impairment that impact information

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processing, multitasking, and decision-making ability.[3-4] Psychologically, ageing has been associated with heightened anxiety, depression, and loneliness, impacting emotional state and self-concept.[5]

The international demographic transition to an ageing population poses humongous challenges to health systems and social protection structures.[6] It is projected that by 2030, individuals over 60 years will constitute 16.67% of the entire world population. India has been estimated to have 13.1% of its population ageing as of 2031.[7] This demographic change has been recognized as important in India's conventional support system, the Northeast, where socioeconomic changes have been remodelling conventional support structures.

In the past, India's conventional joint family structure effectively looked after and supported older people.[8] However, urbanization, migration, and economic change have been observed to destabilize such arrangements, leaving older individuals—especially women—exposed to limited family care availability.[9] It is on this basis that elder people have been driven into institutional care because of economic insecurity, abandonment, social isolation, and widowhood.[10]

Whereas institutionalization has been determined to meet basic needs, physically weak, mentally incapacitated, and psychologically disturbed older persons have been found to be most in need of institutionalization.[11] These conditions have subsequently been preceded by progressive disability and dependency on activities of daily living.

Older people living in old age homes are most vulnerable to physical, mental, and psychological deterioration due to physical inactivity, social isolation, and the psychological effects of family disconnection.[12] Of these residents, females are more susceptible to functional impairment using health problems because of hormonal imbalance after menopause, such as more susceptibility towards osteoporosis, cardiovascular disease, depression, and anxiety.[13-14]

Regular evaluation of physical, mental, and cognitive function has been highlighted as important in tracking decline in overall functional capacity and in targeted intervention to promote the health and independence of the elderly. [15] Few comparative studies of the ageing population's functional ability across various institutions have been made, especially in Northeast India.

OBJECTIVES

1. To assess the literacy level, voluntary admissions, and family visits and to determine their impact on the well-being of the residents.
2. To assess the functional ability of older female residents in two old age homes from two north-eastern states of India.
3. The impact of institutional activities on physical, cognitive, and psychological health outcomes was confirmed, and correlations between structured activity participation and improved functioning were determined.

METHODS

Study Design and Setting

A cross-sectional observational comparative study was conducted in two old-age homes in Northeast India: Apnaghar Old Age Home in Agartala, Tripura, and Ima Leimarel Women Welfare Association in Imphal, Manipur. Data were gathered from October 26, 2024, to December 15, 2024. The research protocol was designed to adhere to the Declaration of Helsinki guidelines and was approved by the Manipur University institutional ethics committee (Ethics approval number: MU/EC/2024/653).

Participants

The study sample consisted of 78 older women participants invited on pre-designed criteria from two old-age homes in Northeast India.

Inclusion Criteria: Women participants aged above 60 years and who could stand and walk independently were included. Participants must be willing to undergo all the test procedures and have the mental capacity to give informed consent.

Exclusion Criteria: Bedridden or walking stick users were excluded .
Subjects having acute illness on the day of evaluation, severe vision impairment to participate in tests, severe hearing impairment to perform the test, and severe cognitive impairment to give informed consent were also excluded.

Sample Distribution

Agartala Group: 46 subjects from Apnaghar Old Age Home, Tripura

Imphal Group: 32 subjects from Ima Leimarel Women Welfare Association, Manipur

Total Sample: 78 participants (4 dropped from a pool of 82)

Assessment Instruments and Materials

Physical Assessment Tools: A Camry EH101 Hand Dynamometer calibrated was used to measure grip strength (Huang *et al*, 2022). A 4-meter walkway was measured and marked to use for gait speed testing. An adjustable chair of height 43-45 cm was used for chair stand testing. Measuring tape and digital stopwatches were used in timed measuring and distance accuracy.

Assessment Forms: Pre-designed standardized data collection forms and demographic questionnaires were developed and distributed.

Data Collection Protocol

Data were determined per standard procedure within eight weeks over three phases:

Phase 1 - Recruitment and Consent: Institutional approval was received, participant eligibility was tested, and informed consent procedures were conducted.

Phase 2 - Physical Tests: Morning sessions were used to conduct SPPB, grip strength was measured in afternoon sessions, and sufficient rest breaks were taken between tests.

Phase 3 - Cognitive and Psychological Tests: Mini-Cog™ was completed under individual testing and WHO-5 under supervised self-report.

Assessment Procedures

Short Physical Performance Battery (SPPB): Three consecutive tasks were performed in a large, well-lit room with non-slippery floors. Balance was measured by testing participants' ability to stand for 10 seconds in three more challenging standing positions (side-by-side stand, semi-tandem stand, tandem stand). Gait velocity was assessed using timed 4-meter walks done in duplicate. Chair stand testing consisted of five successive chair stands done without arm support. Each component was graded using a 0-4-point scale to allow for total scores ranging from 0-12 points.

Hand Grip Strength Test: Subjects were seated in regular armchairs during testing with the Camry EH101 Digital Dynamometer. The elbow was in 90-degree flexion, and the wrist was in a neutral position. The dynamometer handle was adjusted based on hand size. Three maximal voluntary contractions were performed with 30 seconds rest between the tests. The result obtained in the third test was used as a measure.

Mini-Mental Cognitive Test (Mini-Cog™): Testing was done in quiet, well-lit rooms in three steps: word registration of three randomly selected words read to repeat, clock drawing for patients to draw the face of a clock with all numbers and hands at 11:10, and delayed word recall of the three words after clock drawing. Each word recalled earned one point, and two points were given for accurate clock drawing, with scores totalling 0-5 points.

WHO-5 Well-Being Index: Emotional well-being over the past two weeks was assessed by means of five positively worded questions (Heun *et al*, 2001). Self-rating was done on a 6-point Likert scale (0, "At no time"; 5, "All of the time"). The individual items were summed and multiplied by 4 to get final scores between 0-100 points.

Statistical Analysis

Statistical analysis was conducted using SPSS software version 26.0. The statistical analysis process involved normality tests by Shapiro-Wilk tests, calculation of descriptive statistics, independent samples t-tests for normally distributed data, Mann-Whitney U tests for normally distributed data, and calculation of effect size by Cohen's d for continuous data. Statistical significance was determined at $p < 0.05$ with 95% confidence intervals.

RESULTS

Normality Testing Results

Shapiro-Wilk normality testing showed that SPPB and WHO-5 scores were normally distributed ($p>0.05$) and, therefore, suitable for parametric analysis. Mini-Cog™ and grip strength measurements were non-normally distributed ($p<0.05$) and, therefore, suitable for non-parametric analysis.

The distribution pattern of the SPPB score revealed that 50% of Imphal residents had a score of 7 (poor physical function) compared with only 15.21% of Agartala residents. Higher percentages of Agartala residents had scores of eight or more (84.75%) compared with Imphal residents (50%).

Assessment of cognitive function revealed that the residents in Imphal had a larger proportion of 2 on Mini-Cog™ (28.13%) than the residents in Agartala (10.86%), indicating that the residents in Imphal were more prone to cognitive impairment. Psychological well-being distribution revealed that larger proportions of the residents in Imphal had lower scores in range 44-60 (53.13%) than the residents in Agartala (43.47%).

Participant Demographics and Social Context (Table 1)

Table 1. Demographic Characteristics of Study Participants

Variable	Agartala (n=46)	Imphal (n=32)	Statistical Test	p-value
Age (years)	70.37 ± 5.93	69.85 ± 6.12	Independent t-test	0.705
Educational level			Fisher's exact test	0.031*
Literate	7 (15.21%)	3 (9.52%)		
Illiterate	39 (84.78%)	29 (90.48%)		
Marital Status			Chi-square	0.043*
Single	4 (8.69%)	3 (9.38%)		
Divorced	28 (60.86%)	15 (47.62%)		
Widowed	14 (30.43%)	14 (38.10%)		
Nature of admission			Chi-square	0.047*
Voluntary	35 (76.08%)	20 (64.29%)		
Forced by children	7 (15.21%)	8 (23.81%)		
Placed by relatives/others	4 (8.69%)	4 (12.50%)		
Family visitors			Chi-square	0.028*
1-2 visitors	24 (52.17%)	11 (33.33%)		
2-3 visitors	2 (4.34%)	3 (9.52%)		
No visitors	20 (43.47%)	18 (56.25%)		

*Statistically significant at $p < 0.05$

Institutional Environment Characteristics (Table 2)

Table 2. Institutional Environment Characteristics

Characteristics	Agartala (Apnaghar Old Age Home)	Imphal (Ima Leimarel Women Welfare Association)
Physical Activity Programs		
Yoga sessions	Weekly (Professional instructor)	None
Group exercise	Daily (Staff-led)	Occasional (Self-organized)
Gardening activities	Thrice weekly	Weekly
Cognitive Stimulation Programs		
Reading circles	Weekly	None
Memory games	Twice monthly	None
Skills training	Monthly	None
Social Engagement Activities		
Cultural events	Monthly	Quarterly
Group pujas/prayers	Daily	Weekly
Community interactions	Bi-weekly	Monthly
Healthcare Services		
Regular health check-ups	Monthly	Quarterly
Mental health support	Available (visiting counselor)	Not available
Physiotherapy	Available (visiting therapist)	Not available

Functional Status Assessment

Table 3. Detailed Statistical Analysis of Functional Assessment Scores

Parameter	Agartala (n=46)	Imphal (n=32)	Statistical Test	p-value	Effect Size
SPPB Score	8.217 ± 0.917	7.625 ± 1.032	Independent t-test	0.006*	Cohen's d = 0.611
WHO-5 Score	67.91 ± 10.98	61.43 ± 11.76	Independent t-test	0.013*	Cohen's d = 0.567
Mini-Cog™ Score	3.24 (2.0-5.0)	2.88 (2.0-5.0)	Mann-Whitney U	0.037*	r = 0.235
Grip Strength (kg)	14.00 (11.2-17.8)	12.77 (10.1-16.5)	Mann-Whitney U	0.004*	r = 0.327

*Statistically significant at $p < 0.05$

The residents of Agartala exhibited a significantly higher level of physical functioning across all the scales. The residents of Agartala had larger mean SPPB scores (8.217 ± 0.917) than the residents of Imphal (7.625 ± 1.032) with a medium effect size registered (Cohen's d = 0.611, p = 0.006). Higher grip strength was also found in residents of Agartala (13.998 ± 1.891 kg) compared to residents of Imphal (12.765 ± 1.947 kg) with a medium-to-large effect size found (Cohen's d = 0.640, p = 0.004).

Functional Assessment Performance Distribution (Table 4)

Table 4. Functional Assessment Performance Distribution of Participants

Parameter	Agartala (n = 46)	Imphal (n = 32)
SPPB Score		
7	7 (15.21%)	16 (50.00%)
8	28 (60.86%)	12 (37.50%)
9	7 (15.21%)	3 (9.38%)
10	2 (4.34%)	1 (3.13%)
11	2 (4.34%)	0 (0%)
Mini-Cog™ Score		
2	5 (10.86%)	9 (28.13%)
3	33 (71.74%)	18 (56.25%)
4	0 (0%)	0 (0%)
5	8 (17.39%)	5 (15.63%)
WHO-5 Well-Being Score		
44-60	20 (43.47%)	17 (53.13%)
64-80	19 (41.30%)	13 (40.63%)
84-100	7 (15.21%)	2 (6.25%)

DISCUSSION

The detailed study conducted a complete comparative evaluation of functional ability among older women in two old-age homes in Northeast India. Apnaghar Old Age Home, Agartala, reflected better performance on all aspects of functionality than Ima Leimarel Women Welfare Association, Imphal, though with comparable demographic profiles among the groups.

Key Findings and Statistical Significance

Tight adherence to normality testing and appropriate statistical analysis was followed, increasing the validity of findings with small-to-medium (Cohen's d = 0.400 for Mini-Cog™) to medium-to-large effect sizes (Cohen's d = 0.640 for grip strength). Statistical significance of differences in SPPB scores was uncovered by parametric analysis (p=0.006) with medium effect size (Cohen's d=0.611), indicating clinically significant superior lower extremity functioning in Agartala's residents.

Physical Performance Outcomes

In most instances, physical function among residents of both institutions was found to be in the moderate functional category, with greater functioning among Agartala residents. Mean SPPB scores of 8.22 among Agartala residents and 7.63 among Imphal residents confirmed that both institutions had minimum capacity for mobility but had grades of impairment of function.

The differential physical functioning within institutions was explained by structured physical activity interventions conducted in Agartala, such as daily yoga sessions and staff-led group exercises, which were not routinely offered in Imphal.[16]

Cognitive Function Assessment

Cognitive performance scores revealed the broad differential impact of institutional settings on cognitive maintenance. Although education was controlled, Agartala residents exhibited significantly better cognitive functioning (Mini-Cog™: 3.24) than Imphal residents (2.88). The explanation was for cognitive stimulation activities such as ongoing reading clubs, mental games, and skill training in Agartala but not always available in Imphal.[17]

Psychological Well-being Outcomes

A marked difference in psychological well-being scores was seen between centres, with better emotional status found in Agartala residents (WHO-5: 67.91) than in residents of Imphal (61.43). This is noted even though resident populations in both locations had poor social circumstances, such as restricted family contact and diminished natural support systems.

Enhanced psychological outcomes among individuals in Agartala were attributed to extensive social contact activities such as regular group prayers, monthly cultural events, and community contacts every two weeks.[18]

Influence of Institutional Environment

Facility-to-facility variation in functional performance was accounted for, most notably by activity programming and institutional environment variation. Despite seemingly more auspicious demographic conditions in Imphal, such as greater proportions of residents with children and shorter stay lengths, these were inadequate to generate enhanced functional performance relative to Agartala residents, whose higher performance in every functional area was apparent.

This paradoxical finding underscored the significance of programmatic intervention in residential care settings in establishing functional trajectories among older women. The multimodal activity program instituted at the Agartala Centre, with professionally guided yoga sessions, systematic cognitive stimulation, and heterogeneous social engagement activities, triggered a multidimensional enrichment environment fostering physical, cognitive, and psychological functioning.

Limitations of a Study

Some limitations and constraints were identified in this research. The cross-sectional design excluded causal inference from functional status and institutional environments. Longitudinal designs with follow-up across time, assessing change in function as it develops, would offer more compelling evidence for institutional programming effects on maintenance or decline of function.

The female restriction confined generalizability to mixed-sex or male settings. Functional decline patterns and gender-divergent intervention responses may exist, necessitating comparative gender-group research to establish prevailing care models.

CONCLUSIONS

The evidence supports statistical evidence that active involvement in the form of activity programming is superior to passive social support in the preservation of functional capacity among institutionalized older women. Despite higher sociodemographic status in Imphal, Agartala residents continued to outperform other city residents in all functional domains, as outlined, to underscore the key role of comprehensive activity planning in institutions' care settings.

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Can Prolonged Type 2 Diabetes Mellitus in Older Persons be Controlled by OHA Alone ?

Greeshma SR[1], KP Poulose[2], Jithin VP[3]

Abstract

Background: *The present study was conducted to assess the duration of the disease, type of treatment and associated comorbidities in patients above 60 with Type 2 DM.*

Materials and methods: *The study was conducted in the Department of Medicine, SUT hospital, Pattom (Trivandrum). The data was collected from patients attending our Out Patient clinic at SUT Hospital, Pattom.*

Results: *Out of a total study population of 105 with age >60yrs with Type 2 Diabetes mellitus (DM) for more than 20-40 years duration, only 51 were on insulin (49%) and 54 on Oral hypoglycemic agents (OHA) (51%). 3 out of the 105 patients did not have any co-morbidities. Study population included 53 males and 52 females. Our study revealed that Chronic Kidney Disease (CKD) was significantly associated with patients who were on insulin treatment (p value of .006)*

Conclusion: *In Type 2 DM patients, with regular follow up, blood glucose level can be brought under good control with proper oral hypoglycaemic agents alone.*

Keywords: *Insulin, OHA, Diabetes mellitus, Chronic kidney disease*

INTRODUCTION

Diabetes is a chronic clinical syndrome characterized by hyperglycaemia due to absolute or relative deficiency of insulin, or both, which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves.[1]

In the past 3 decades the prevalence of type 2 diabetes has risen dramatically in countries of all income levels.

About 800 million people worldwide have diabetes, the majority living in low-and middle-income countries, and 1.5 million deaths are directly attributed to diabetes each year.

In India, an estimated 212 million people above the age of 18 years are suffering from diabetes (type 2) and nearly 25 million are prediabetics. More than 50% of people are unaware of their diabetic status (especially hypoglycemia in prolonged diabetes) which leads to serious complications if not detected and treated early.

It is estimated that 135.6, million people aged 65-99 yrs are living with Diabetes mellitus world wide, which accounts for 20% of people at that age group. According to the Longitudinal Survey of India, the prevalence of Type 2 DM in people above 60 years is 34.75% in India. Several sociodemographic factors can influence HbA1C level such as age, economy, education, disease awareness and adherence to treatment.[2]

Diabetes mellitus can be controlled with lifestyle modifications and various oral hypoglycemic agents such as biguanides, sulfonylureas, DPP 4 inhibitors, glitazones, SGLT-2 inhibitors and alpha glucosidase inhibitors and alternatively insulin. Diet modification and regular exercise are also important parts of treatment.

METHODOLOGY

Study Population

Study population included patients with history of Type 2 diabetes for more than 20 years duration (20-40yrs) who attended our OPD at SUT Hospital, Pattom, Trivandrum. The age of the patients ranges from 60 to 85 yrs. We categorized them into patients on insulin and on OHA. Data regarding other comorbidities were also collected and comparisons were done (whether they were on

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OHA or Insulin). Tables & bar diagrams were made for better data analysis. Differences in comorbidities were assessed by chi- square test to verify the significance between patients on OHA and insulin. Many patients on insulin were also receiving OHAs. All the patients with complications were seen by respective specialty departments and treated with their concurrence.

Diabetes in patients was defined as one taking medication for diabetes (treated diabetes), or having a fasting plasma glucose (FPG) of 126 mg/dl or more, or an HbA1c of 6·5% or more (untreated diabetes).

RESULTS

(Table 1,2,3 and figure 1)

Table 1 shows the treatment modality followed for glycemic control among the study population of 105 patients. Study population included 53 males and 52 females. 54 patients were on oral hypoglycemic agents and 51 were on insulin therapy.

Table 2 and Figure 1 shows the prevalence of comorbidities in these patients and the mode of treatment.

Table 3 shows 77% patients with CKD were taking insulin and only 23% were on OHA. This difference was statistically significant (0.006).

In patients with other comorbidities there were no statistically significant difference in treatment between Insulin and OHA.

DISCUSSION

There's a general impression that people with more than 10-15yrs duration of diabetes may require insulin and our study is focused mainly to verify this assumption.

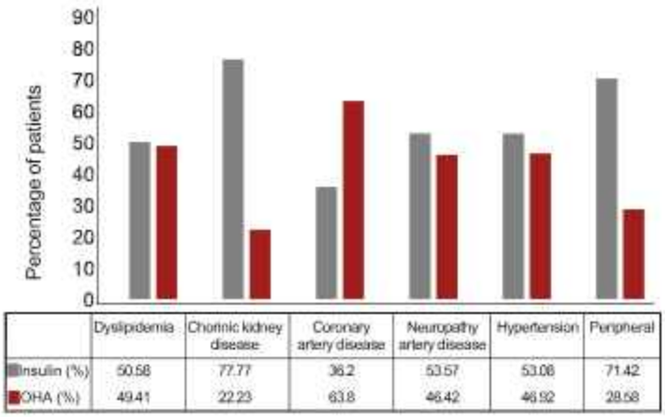

Figure 1: Presents the percentage of patients with comorbidities and treatment

Out of total study population of 105 with DM for more than 20 to 40 years, only 51 were on insulin (49%). Three patients did not have any comorbidities. This study found that only Chronic kidney disease patients were significantly associated with diabetes treatment with insulin (p value of .006).

There were no significant association between dyslipidemia, coronary artery disease, peripheral neuropathy or hypertension with the mode of treatment or the duration of the disease. 85 out of 105 have dyslipidemia (81%), 18 out of 105 have chronic kidney disease (17%), 58 out of 105 have coronary artery disease (55%), 56 out of 105 have peripheral neuropathy (53%), 81 out of 105 have hypertension (77%) and 7 out of 105 have peripheral arterial disease (7%). Comorbidities were seen more in patients with prolonged diabetes; the more the duration the more is their presence (Table 3).

Out of 85 with Dyslipidemia 43 were on insulin (51%), Out of 18 with Chronic kidney disease 14 were on insulin (78%), Out of 58 with Coronary artery disease 21 were on insulin (36%), Out of 56 with neuropathy 30 were on insulin (54%), Out of 81 with hypertension 43 were on insulin (53%) and Out of 7 with peripheral artery disease 5 were on insulin (72%) (Table-2, Figure-1)

All patients with CKD and eGFR of less than 35 were on insulin therapy.[3] Dose of OHAs were reduced according to the GFR value and among DPP-4 inhibitors only linagliptin was used in Chronic kidney disease patients.[4] Indications for starting insulin therapy

Table 1: Treatment

Treatment	(Total Patients: 105)
OHA	54 (51%)
INSULIN	51 (49%)

Table 2: Comorbidities & treatment modality

	Total patients	Insuin	OHA	P value	Significant /Not significant
Dyslipidemia	85	43	42	0.393	NS
CKD	18	14	4	0.006	S
CAD	58	21	37	0.188	NS
Neuropathy	56	30	26	0.233	NS
Hypertension	81	43	38	0.089	NS
PAD	7	5	2		

CAD-Coronary Artery Disease, PAD-Peripheral Artery Disease

Table 3. Relation between duration of DM and comorbidities

Duration of DM (years)	No. of patients	Hypertension		Neuropathy		Coronary Artery Disease		Chronic Kidney Disease		Dys lipidemia		Peripheral artery disease	
20-25	46	38	84%	24	52%	28	61%	6	13%	39	85%	1	2%
26-30	25	18	72%	12	48%	12	48%	4	16%	19	76%	3	12%
31-35	19	15	79%	11	58%	9	47%	4	21%	15	79%	2	11%
36-40	15	10	67%	9	60%	9	60%	4	27%	12	80%	1	7%

are poorly defined in guidelines and still subject to individual judgement based on a wide range of opinion.[5] Aggressive weight loss strategies together with the new glucose-lowering drugs which do not cause hypoglycemia nor weight gain should limit the number of patients with type 2 diabetes needing insulin.

CONCLUSION

It is a misconception that all patients with comorbidities need insulin treatment. In a good percentage of patients, with regular follow up, with oral hypoglycemic agents alone, diabetes mellitus can be brought under good control without insulin.

In Chronic kidney disease patients, oral hypoglycemic agents should be given with at most care to avoid hypoglycemia.

Table 2 presents comorbidities & treatment modality followed. Statistically significant difference was seen only in patients with Chronic kidney disease who were on insulin as compared to OHA (P value 0.006).

Figure 1 presents the percentage of patients with comorbidities and treatment.

Table 3 shows the relation between duration of DM and comorbidities. The prevalence of comorbidities like Hypertension, Coronary artery disease and CKD are more seen in patients with longer duration of Diabetes mellitus as expected.

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Comprehensive Geriatric Assessment (CGA)

Chinmoy Kumar Maity[1]

Abstract

CGA is effective in (a) reducing mortality and improving independence for the older people admitted to hospital as an emergency compared to those receiving usual medical care, (b) Reducing hospital admission and readmission, if CGA is practiced in community settings, (c) Reducing impact of frailty, by early identification of areas for improvement and appropriate interventions and (d) Reversing the progression of frailty, through individualized care planning.

Keywords: *Comprehensive geriatric assessment, frailty scale, Beers criteria, independent mental capacity advocate, comprhensive primary healthcare*

INTRODUCTION

The concept of Comprehensive Geriatric Assessment (CGA) is neither new nor any rocket science. It is the very essence of Geriatric Medicine and is there since the very inception of this specialty. Only the concept has evolved over time and the mode of its delivery is changing as regards to whom, when, where and how this could be implemented.[1,2,3]

As most elderly patients are at the centre of a complex milieu of physical, psychological, functional, socioeconomic and environmental problems, their proper assessment should be holistic and multi-dimensional and this should be carried out by a team of trained professionals called Multi-disciplinary Team or MDT. The MDT should consist of doctor, nurse, physiotherapist, occupational therapist, speech and language therapist, psychologist, pharmacist, social worker, family members and if necessary, some other specialists, e.g. neurologist, psychiatrist etc.[4,5]

The concept of MDT assessment and its regular practice is there in the hospital inpatient settings for the hospitalized frail elderly patients in most developed countries for decades; but the domain has now expanded to hospital outpatient settings, day centers, GP surgery, specially set community clinic and even at the patient's own home.

Though the concept of CGA originated from the UK in 1940s, it's firm scientific base was established through several randomized controlled trials (RCTs) and meta-analysis in 1980s and 1990s and CGA is in full practice since the beginning of this century.[6-12] Countries across the globe including India are adopting this practice with necessary modifications according to their own economic and sociocultural needs. Developed countries like the UK and other European countries with well-developed healthcare systems took a "Top-down" approach from tertiary hospitals to primary care for implementing CGA. However, in India with a developing healthcare system and a relatively more organized primary healthcare set-up, the government has taken a "Bottom-up" approach from primary care to tertiary care settings for the implementation of CGA.

Though CGA is designed for frail elderly patients, this can be very much applicable and beneficial for younger patients with complex multi-dimensional problems, e.g. young stroke patient with significant neuro-deficits.

DEFINITION

CGA – is a process of care related to the health and well being of a frail elderly comprising of:

1) A multi-dimensional holistic assessment:
   a) General multi-dimensional assessment (physical/ psychological / functional / socioeconomic / environmental/ medication review).
   b) Special assessment for specific presentations like – Instability & falls / Bone health / Incontinence / Depression / Delirium & dementia / Mental capacity issues / Weight loss & nutritional issues / End of life care issues.
2) Formulation of a problem list.
3) Realistic Goal Setting.
4) Personalized Care and Support planning.

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5) Appropriate interventions.
6) Regular review with necessary modifications.

Proper implementation of CGA is possible only through the active and coordinated actions of a dedicated multi-disciplinary team (MDT). CGA is also known as COAA (Comprehensive Older Age Assessment) or GEMT (Geriatric Evaluation Management and Treatment).[13]

EFFECTIVENESS OF CGA – Available evidence shows that CGA is effective in:[14,15]

1) Reducing mortality and improving independence for the older people admitted to hospital as an emergency compared to those receiving usual medical care.
2) Reducing hospital admission and readmission, if CGA is practiced in community settings.
3) Reducing impact of frailty, by early identification of areas for improvement and appropriate interventions.
4) Reversing the progression of frailty, through individualized care planning.

WHO DOES CGA? – the co-ordination of CGA can be done by any member of the health and social care team, especially by someone whom the patient and their family trust and with whom they can have open and sensitive discussions. So, the coordinator of CGA may be anyone of the followings:

1) The Geriatrician in charge of the patient.
2) The General Practitioner (GP).
3) The Nurse.

WHEN IS CGA DONE? – CGA should be considered appropriate in circumstances reflecting the presence of frailty syndrome in that individual. These circumstances may be identified –

Figure 1. The figure demonstrates the processes of CGA

1) At home, when the GP or community team comes to know about an incident which implies frailty in the concerned individual.
2) At the GP surgery, when an older person presents to their GP with one or more obvious frailty syndromes, e.g. falls, confusion, incontinence etc.
3) At hospital, when an elderly person has been discharged from hospital after presenting with a frailty syndrome, e.g. instability, falls, delirium etc.
4) CGA as a part of process of proactive preventive care, may be applied to the target population for the identification of frailty through risk stratification by using standardized tools, e.g. Electronic Frailty Index (EFI).

WHERE IS CGA DONE? – CGA can be performed in any of the following places – Patient's home, GP surgery, Special Clinic set up, Day Care center, hospital outpatient department (OPD) and hospital inpatient (IP).

FRAILTY - is a common Geriatric syndrome which literally means – the condition of being weak and delicate.

Definition - Frailty is a geriatric syndrome resulting from age-related cumulative declines across multiple physiologic systems, with impaired homeostatic reserve and a reduced capacity of the organism to withstand stress, thus increasing vulnerability to adverse health outcomes including falls, hospitalization, institutionalization and mortality.

The commonly used Frailty Scales are as follows:

LINDA FRIED /JOHNS HOPKINS FRAILTY SCALE (2001)

Those who meet at least three of the following five criteria are defined as frail and those not matching any of the five criteria are defined as robust / non-frail.

1) Unintended weight loss (>4.5 kg in the past year)
2) Weakness (grip strength dynamometry – weakest 20% by gender and BMI).
3) Slow gait speed (4 metre walking test – slowest 20% by gender and height).
4) Low physical activity (<383 kcal/week in male and <270 kcal/week in female).
5) Self-reported exhaustion (unusually low energy level / weak / tired most of the time).

ROCKWOOD FRAILTY SCALE (2005)

A semi-quantitative tool used to estimate an individual's degree of frailty on a scale of 1–9.

(Very fit / Well / Managing well / Vulnerable / Mildly frail / Moderately frail / Severely frail / Very severely frail / Terminally ill).

- **Score 1** – very fit.
- **Score 9** – terminally ill.
- **Score ≥ 5** – is considered frail.

SHARE-FRAILTY INDEX (2010)

It consists of five domains of frailty phenotype: Fatigue / Loss of appetite / Grip strength / Functional difficulties / Physical activity.

- **Score (0) -** Non-frail / robust / strut.
- **Score (1-2) -** Pre-frail.
- **Score (3-5) –** Frail.

ELECTRONIC FRAILTY INDEX (EFI) (2016)

EFI is a population risk stratification tool, not a clinical diagnostic tool, which was developed and validated in England using GP data.

It uses routinely collected primary care data existing in electronic health records and a 'cumulative deficit' model to measure frailty on the basis of the accumulation of a range of deficits.

As individuals interact with GP practices, their records accumulate a list of read codes and community prescriptions.

EFI uses a subset of these read codes to interpret any number up to 36 potential deficits, which comprises of some signs and symptoms, disease states, disability or abnormal laboratory values. The number of deficits that an individual is considered to have, is then divided by the total (36) to produce a score.

This score can be calculated for an individual, or for a whole GP practice population.

ELECTRONIC FRAILTY INDEX (EFI) → Frailty Score.

Example – If an individual has 9 deficits from a total of 36, the frailty index / score is (9/36) = 0.25.

Scores of 0.20 and above are considered as approaching frailty.

On the basis of the 'Frailty Score' calculated from EFI, a person can be categorised in to one of the following 4 groups:

MAKING CGA WORK – the key processes supporting proper and effective implementation of CGA are –

1) Development of a multi-disciplinary team (MDT) – comprising of doctor, nurse, therapists, psychologist, pharmacist, dietician, social worker and specialists.
2) Clear identification of a joint core level of competence for assessment.
3) Development of a clear referral pathway for specialist's assessment.
4) Single patient-held documentation.
5) Information sharing system.
6) Regular MDT review meetings to enhance team working.
7) Sorting out necessary funding allocation.
8) CGA is time-consuming – so, needs adequate time allocation.

GENERAL MULTI-DIMENSIONAL ASSESSMENT

PHYSICAL ASSESSMENT – for carrying out all standard clinical examinations on older people, we may have to allow some general considerations and modifications as follows:

1) Frail elderly may find clinical examination challenging or tiring – so, it may have to be deferred or completed in multiple sessions.
2) Frail patients with poor mobility, skeletal deformity or advancing organ failure will need modified posture and support during examinations.
3) Assessment of non-concordant patients has to be carried out in the best interest of the patient using provision of mental capacity legislation.
4) Gross hearing and visual testing are necessary to find out any sensory loss.
5) Examination of feet and footwear are crucial for patients with gait and balance problem.

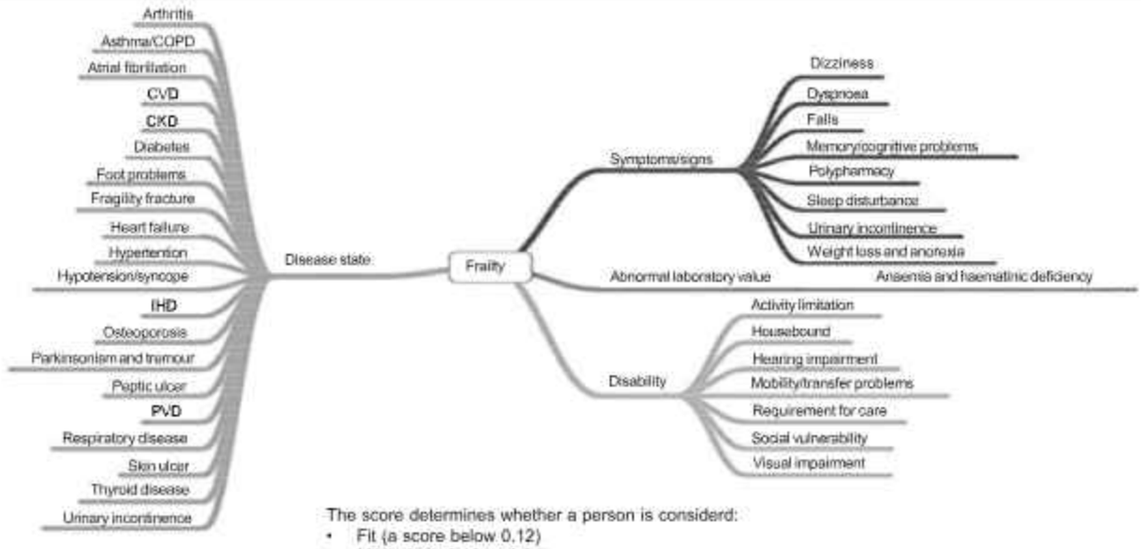

Figure 2. Electronic frailty index

6) Gait and balance assessment by critical observation, Timed Up and Go (TUG) test or formal balance scoring using Berg Balance Scale.
7) Lying and standing BP measurement is essential for patients with dizziness and falls.
8) General gross assessment of cognition and mood, functional ability, joint pain or deformity may guide further detailed formal testing.
9) Weight monitoring and nutritional assessment including observation for oral health is useful.
10) Per rectal, genital and breast examinations may be necessary to complete the assessment.

PSYCHOLOGICAL ASSESSMENT - as mental health problem is very common in the elderly, it is vital to assess their mood and cognition for a complete CGA.

1) Depression (5-10%) and suicidal thoughts are common in older people, especially in older male and those with social isolation, bereavement, chronic painful illness, disability, drug or alcohol use and previous suicidal attempts.
2) Some simple screening questions may help:
   a. Do you often feel down, hopeless or lonely recently?
   b. Have you lost interest or pleasure in doing things?
   c. Do you ever sit and cry for no reason?
3) Formal detailed assessment of depression may be necessary using tools like Geriatric Depression Scale.
4) Cognitive dysfunction is also common in the elderly and a simple screening question may unfold the underlying issue, e.g.-
   a. Has the person been more forgetful in the last 12 months to the extent it has affected their daily life? E.g. difficulty using phone, using money, driving, managing shopping lists or managing their medication.
5) The rate of decline is vital to distinguish delirium from dementia.
6) Commonly used formal assessment tools for cognition are:
   a. GP-Cog Test.
   b. Hodkinson's Abbreviated Mental Test Score (AMTS).
   c. Folstein's Mini Mental State Examination (MMSE).
   d. Montreal Cognitive Assessment.

FUNCTIONAL ASSESSMENT – covers a wide range of factors like mobility, vision, hearing, activities of daily living and the ability to interact with technologies used for telecare.

1) There are two components of functional assessment:
   a. What can and what does the person actually do?
   b. How recently has it changed?
2) Common tools used for functional assessment:
   a. Barthel Index / Katz Index / Nottingham Extended Activities of Daily Living Scale.
   b. Timed Up and Go Test (TUGT).
3) Assessment of the timescale of change guide us to select appropriate management.
   a. Sudden loss of function → acute illness → active investigations and management.
   b. Slow progressive loss of function → age-related / degenerative changes → supportive care environment.

SOCIOECONOMIC ASSESSMENT – Social and financial situations directly affect the physical and mental wellbeing of a person and so,

- It is of utmost importance that the health care professionals are fully aware of a patient's social circumstances and support structures in order to best tailor their advice and support.
- Social and financial assessments are best done by the patient, their relatives, social worker or GP.
- There are two models of socioeconomic assessment:
  a) Questioning Model – the assessor asks a series of pre-determined questions and he / she is seen as the expert.
  b) Exchange Model – this is increasingly more used and here the patient acts as the driver for the exchange related to individual needs and wishes.

ENVIRONMENTAL ASSESSMENT – assessment of the living environment of a patient is very important to detect environmental hazards leading to recurring health hazards like falls with it's consequences.

- Common environmental hazards, those can be modified to improve safety of patients at their living environment are –
  a) Uneven floors or road surfaces
  b) Poorly fitted carpets.
  c) Wet or slippery surfaces.
  d) Poor lighting.
  e) Steep stairs without hand-rails.
  f) Inappropriate placement of indoor furniture.
  g) Dirty, dusty, damp and unhealthy home environment etc.

MEDICATION REVIEW – Medication review is a core component of CGA. The reasons behind this are -

1) Most of the older people with multiple comorbidities are on polypharmacy, i.e. taking five or more medicines daily.
2) 30% of Geriatric hospitalizations are due to drug induced complications!
3) The evidence base for guideline-based prescribing may not be directly relevant to frail elderly.
4) Even once established medications may no longer be useful.
5) Many medicines used for long-term risk reduction may be less relevant to patients with limited lifespan and their use may not reflect their current priorities.
6) Judicious review of medications, their indications, benefits, side effects and interactions with necessary modifications can cause significant and rapid improvements of patient's condition.

A general approach to medication review includes:

1) Obtain full medication history
   - Primary care prescribed medications.
   - Prescribed medications from other providers.
   - Other (non-Allopathic) medications taken.
   - Over the counter medications.

- Herbal supplements, vitamins etc.
- Illicit drugs.

2) Review medication use in general and for each medication.

A. In general, ask the patient:

- Are you good at remembering your pills?
- Can you swallow them ?
- What are you most concerned with your pills?

B. For each medication, ask the patient:

- Do you take this pill?
- How often do you take this?
- What for do you take this?
- Do you think it works?
- Does it have any side effects?

3) Review full drug list for possible side effects and interactions.

4) Obtain detailed medical history and current disease status to assess appropriateness of prescribing and patient understanding:

- If on anti-anginals – "How often do you get angina?"
- If there is a previous history of stroke – "Why are you not taking a blood thinner?"
- If on pain killers – "What type of pain do you use this painkiller for? Does it work?"
- Direct questioning if possible issues identified – "Do you suffer from constipation?"

5) Review each medication for appropriateness.

6) List and prioritize medication related issues and discuss changes with patient.

- Any high-risk prescribing should be changed urgently.
- Patient priorities are very important to both guide the process and build trust.
- Change should generally be introduced progressively over time unless there is a significant, urgent problem.
- New medications should also be introduced one by one, to avoid confusion if prescribing or de-prescribing causes new symptoms.
- Reduce old medications gradually if necessary to avoid rebound effects and introduce new medications gradually too – **start low and go slow**.
- Arrange review to assess progress and modify accordingly.

7) Some useful tools for medication review are – NO TEARS / STOPP-START / MAI (Medication Appropriateness Index) / Beers Criteria.

NO TEARS – this tool was developed in primary care and it comprises a set of questions as follows:

- Need and Indication.
- Open Questions.
- Tests and Monitoring.
- Evidence and Guidelines.
- Adverse Events.
- Risk reduction or Prevention.
- Simplification and Switches.

STOPP-START – Screening Tool of Older Persons' Prescriptions (STOPP) and Screening Tool to Alert to Right Treatment (START).

- STOPP-START criteria are composed of a total of 114 criteria, 80 STOPP and 34 START, which were formed using a Delphi consensus methodology, by a panel of doctors, pharmacists, pharmacologists and primary care physicians with expertise in geriatric medicine and pharmacotherapy in the elderly population from 13 countries in Europe.
- Tool Kits are available online for use.

MAI – Medication Appropriateness Index is –

- A framework for assessment of medications for older people.
- This tool is straightforward but painstaking as time needed increases progressively as new medication added.
- It is considered the most reliable and valid instrument to measure medication appropriateness.
- It uses 10 criteria for each medication prescribed. Each criterion is assigned a score of 1-3, with a maximum total score of 18.
- MAI Scoring – for items coded as inappropriate, the relative weight of individual criteria is applied to calculate a summed MAI score per drug.
- However, clinically relevant threshold for a specific change is not established.

	Item / Criteria of MAI	Weight / Score
1.	Is there an indication for the drug?	3
2.	Is the medication effective for the condition?	3
3.	Is the dose correct?	2
4.	Are the directions correct?	2
5.	Are the directions practical?	1
6.	Are there clinically significant drug-drug interaction?	2
7.	Are there clinically significant drug-disease/ condition interaction?	2
8.	Is there unnecessary duplication with other drug(s)?	1
9.	Is the duration of therapy acceptable?	1
10.	Is this drug the least expensive alternative compared to others of equal efficacy?	1

BEERS CRITERIA – first developed in 1991 by a Geriatrician, Dr. M H Beers from the University of California and now maintained and updated by American Geriatrics Society (AGS). These are a set of guidelines that help healthcare professionals identify and address potentially inappropriate medications use and thus can help reduce polypharmacy, drug interactions, and adverse drug reactions in older adults. These were last updated in 2023 and are organized into five categories as follows:

1) Medications to Avoid.
2) Medications to Avoid in Specific Health Conditions.
3) Medications to Use With Caution.
4) Medications to Avoid Due to Drug Interactions.
5) Medications With Renal Adjustments.

SPECIAL ASSESSMENT FOR SPECIFIC SITUATIONS - are necessary in the following situations:

INSTABILITY & FALLS

Impaired gait, balance and strength are key risk factors for falls and targeted interventions to improve these can prevent falls. A thorough and systematic approach to include:

- Establishing current and prior function through detailed history taking.
- To determine "what the patient needs to be able to do" for a realistic goat setting.
- Gait and balance assessment simply by watching the patient walk.
- Detailed history of falls, thorough physical examination, medications review, lying and standing BP, ECG, home hazards assessment etc. are crucial.
- **Simple tests for walking and balance** – the commonly used tests are:
  1) Timed Up and Go (TUG) Test – normal <13 seconds.
  2) 180 degree turn test – normal < 5 steps.
  3) Gait speed test – normal > 0.8 m/sec.
  4) Chair stand test – normal persons should be able to stand up from chair without the use of their arms.

BONE HEALTH PROBLEMS

Patients with fragility fractures and those with increased risk of falls from instability should have their bone health and osteoporosis risk assessed.

Common bone health problems in the elderly are – Osteoporosis, Osteomalacia, Vitamin D deficiency, Paget's disease of bone, Hyperparathyroidism, Primary and metastatic malignancies of bones.

Comprehensive assessment of bone health should include:

- Detailed history – bone pain / loss of height / change of posture / weight loss / previous fracture / age at menopause / steroid therapy / dietary history / Alcohol / Smoking / Sunlight exposure / Exercise / Family history of osteoporosis etc.
- Detailed physical examinations – including height / weight / posture / joints and muscle strength.

Screening tools for Osteoporosis risk assessment – commonly used tools are:

- Q Fracture – in primary care.
- FRAX (Fracture Rist Assessment Tool).

CONFUSION & DELIRIUM

Delirium is an acute confusional state, usually with a fluctuating course, characterized by disturbed consciousness and cognition or perception. It is usually caused by an acute medical disorder, substance intoxication / withdrawal or medication side effects.

Delirium is very common in the elderly – 1-2% in community / 14% in above 85 yrs / up to 60% in NH residents and post-acute care settings.

Risk increases with age / underlying dementia / severe illness / polypharmacy etc.

Diagnosis of Delirium – commonly used tools are:

A. The Single Question in Delirium test - can pick up 80% cases by asking the question: "Do you think that the patient is more confused lately?"
B. Confusion Assessment Method (CAM) – can diagnose delirium in the presence of 1 & 2 plus either 3 or 4 of the following 4 items:
   1) Acute onset and fluctuating course.
   2) Inattention / difficulty focusing.
   3) Disorganized / incoherent thinking.
   4) Altered level of consciousness.

COGNITIVE IMPAIRMENT & DEMENTIA

It is a common problem in the elderly and the prevalence of dementia progressively increases with increasing age – 1% at 60 yrs to 50% at 95 yrs of age.

Impaired memory or Cognitive impairment is present when a person has trouble remembering, learning new things, concentrating, or making decisions.

Mild cognitive impairment (MCI) is a state intermediate between normal cognition and dementia, with essentially preserved functional abilities. It is also known as "Cognitive Frailty".

Dementia is a syndrome usually chronic, characterized by a progressive, global deterioration in intellect including memory, learning, orientation, language, comprehension and judgment due to disease of the brain.

Dementia is typically diagnosed when acquired cognitive impairment has become severe enough to compromise social and/or occupational functioning, e.g. difficulty using money, phones and cars, managing shopping lists and medications etc.

DELIRIUM	DEMENTIA
Acute / sudden onset	**Insidious onset**
Usually reversible	Slowly progressive
Short duration	Long duration
Fluctuating course	Relatively stable
Altered consciousness	Normal consciousness
Associated acute illness	No associated acute illness

URINARY INCONTINENCE (UI) – is defined as any involuntary leakage of urine.

UI is very common in the elderly – 10-15% above 65yrs / 50% in Nursing Home residents.

Lower urinary tract symptoms (LUTS) is the generic description for symptoms of bladder dysfunction and symptoms of urinary incontinence may be divided into:

- Irritative / urge incontinence.
- Obstructive / overflow incontinence.
- Stress incontinence
- Mixed incontinence
- Continuous incontinence
- Post-micturition dribble (PMD)
- Nocturnal enuresis.
- Functional incontinence.

Assessment of urinary incontinence is done through:

1) Detailed History taking
2) Frequency/Volume Voided Chart
3) Thorough Physical Examination
4) Investigations:
   a. Urine RE & CS
   b. USG of KUB
   c. X-Ray KUB / IVU / CT of KUB
   d. Urodynamic investigations – Uroflometry / Cystometry / Videourodynamics.

Management of urinary incontinence is multi-dimensional as follows:

1) Behavioural therapy.
2) Bladder training.
3) Changes in lifestyle.
4) Pharmacological therapy, including antibiotics for UTI.
5) Neuromodulation with electrical stimulation.
6) Continence gadgets – hand-held urinals, bedside portable commodes, adult diapers, condom catheter, urethral / supra-pubic catheterization.
7) Surgery, e.g. transurethral resection of prostate (TURP) for benign prostatic hypertrophy (BPH).

MENTAL CAPACITY ISSUES

Assessment of capacity to make decisions should be a routine part of CGA. Mental capacity is defined under law in respective countries, as The Mental Capacity Act 2005 in England & Wales.

Principles – mental capacity assessment should follow the following principles:

- Capacity is assumed to be present unless proved otherwise. The onus is on the person assessing capacity to provide evidence of its absence.
- Individuals should receive all supports they require to make their own decisions.
- Individuals have the right to make decisions others may see as unwise or eccentric, but the reasons for eccentric decisions should be explored.
- Decisions made on behalf of people lacking capacity must be in their best interests.
- Interventions made on their behalf must be the least restrictive option.
- Capacity to decide is specific to the decision in question, not all decisions.
- If the reason for lacking capacity is reversible and the decision can be delayed, the assessment should wait until the person has recovered.

Testing Capacity – there is no such thing as a "general test of capacity". It is always specific to the decision in question and can be done by any professional with appropriate training.

There are two stages to the test of capacity as follows:

- The patient is unable to make a decision due to a condition of mind or brain, like delirium, dementia, severe depression and learning disability etc. So, in the absence of any such condition of mind or brain, the capacity should be assumed to be present.
- The person cannot understand, retain, weigh up or communicate information relevant to the decision in question.

Both stages of the test must be satisfied in order to confirm lack of capacity and the reasons must be clearly documented.

Advance Care Planning – Advance care planning for a person who has lost capacity must be in his best interest and least restrictive, taking into account his previous wishes and feelings, which may be established by:

- A Written Advance Statement.
- The views of a legal proxy / attorney with powers appropriate to the decision in question.
- Verbal statement made by the person before the capacity was lost.

Seeking views of those close to the patient and other members of the healthcare team is considered good practice.

Advance decision to refuse treatment (ADRT) – must be both valid and applicable.

- "Valid" means the document is signed by the patient, dated and witnessed and there is no evidence that the patient has changed his mind subsequently.
- "Applicable" means the ADRT is relevant to the current situation.

Powers of Attorney – a person with capacity (the donor) can appoint another person (the attorney) to make decisions on their behalf when they lose capacity.

- Attorneys may be appointed for property and financial affairs, and / or health and welfare decisions.
- Lasting Powers of Attorney must be registered with the Office of the Public Guardian before coming into effect.

Independent Mental Capacity Advocate (IMCA) – is not a lawyer, but they are trained to support people who are unable to make decisions for themselves. To have an IMCA appointed the patient must be:

- Aged 16 years or above.
- Unfriended, means they do not have any responsible relatives or friends to support.
- Do not have a 'lasting powers of attorney'.

WEIGHT LOSS AND NUTRITIONAL ISSUES

Recognition of nutritional problems in the elderly is important, as these are associated with poor prognosis and are potentially treatable.

Frequently used risk factors for malnutrition are:

1) Involuntary weight loss (>5% over last month / >10% over last 6 months).
2) BMI < 20 for the elderly.
3) Reduced appetite or food intake.

Assessment – Nutritional status can be easily assessed using some basic tools like:

1) Weight Chart.
2) Body Mass Index (BMI).

3) Malnutrition Universal Screening Tool (MUST).
4) Mini Nutritional Assessment (MNA).

Common Causes for malnutrition – can be either due to poor nutritional intake or excess utilization from:

- Poor Oral / Dental Health (including denture).
- Change in taste.
- Swallowing problems.
- Chronic Constipation.
- Depression or Dementia.
- Excess Alcohol intake.
- Uncontrolled DM or Hyperthyroidism.
- Underlying Malignancy or TB.

Management of Malnutrition – depends upon the underlying causes:

- Underlying secondary causes must be identified through proper investigations and treated accordingly.
- Referral to local dietetics service may be cost-effective.
- Oral Protein and Energy supplementation may be helpful.
- Decisions on supplemental feeding through enteral route for patients with swallowing problems may be complex, especially for frail elderly.
- Medications to stimulate appetite are rarely effective.
- The effects of increased nutritional support may be negligible or even harmful in patients with advanced frailty and dementia.

END OF LIFE CARE ISSUES

Many principles of care at the end of life are shared with CGA, as with advancing frailty the philosophy of treatment gradually shifts from active curative treatment towards palliative symptom management.

End of life care (ELC) ideally refers to the care during the last few days or hours of life.

It could be very challenging to the healthcare team, the relatives and the patients themselves to recognize precisely the time near to the end of life.

The timeline for ELC is very uncertain, ranging from hours to months. In the United Kingdom, according to National Institute of Health & Clinical Excellence (NICE) Guidelines, this timeline is one year.

Here the priority revolves around – maintenance of comfort and dignity and adequate control of pain and distress.

Religious and cultural attitudes to death and dying may make our decision making very challenging.

An individualized approach based on local guidelines may be the key to successful implementation of an end-of-life care plan.

CREATING A PROBLEM LIST

After the detailed assessment, the problem list must be developed in collaboration with the patient and / or caregiver.

It should be individualized and patient-centric, reflecting concerns of the patients and their relatives.

The Problem list should help to identify all acute, subacute and chronic problems which may interact.

The Problem list should also help with prioritization so that acute and more serious problems are dealt with first.

As the problems may change over time, the problem list and goals may change / evolve over time.

Necessary laboratory investigations should be carried out as guided by signs and symptoms of ill health. Investigations should initially be confined to simple, inexpensive, easily performed and not distressing tests.

The creation of the problem list in full will help in the generation of the care plan.

CARE AND SUPPORT PLANNING

It is "a powerful way of creating an environment which helps clinicians to support self-management by patients of their own long-term condition".

"Everyone with long term conditions, including people with mental health problems, should be offered a personalized care plan that reflects their preferences and agreed decisions".

Realistic Goal Setting is an important part of care planning and an effective goal setting should be "SMART":

- **Specific** – for both the goal and the action plan.
- **Measurable** – continuous monitoring / tracking of the progress of achievement.
- **Achievable** – goals must remain within the realms of achievability.
- **Relevant** – goals must be relevant to the patient and their situation.
- **Timely** – is it possible to make a difference in a relevant time frame and when should things be reviewed?

SUMMARY

What is Comprehensive Geriatric Assessment (CGA)?

1. Thorough holistic Geriatric consultations (single / multiple).
2. For the frail elderly with multi-dimensional (physical / functional / psychological / socioeconomic / environmental) problems.
3. Multi-dimensional assessment by MDT including Medication review.
4. Creation of problem list and personalized care plan.
5. Implementation of appropriate Intervention.
6. Regular planned review with necessary modification.

What is it (CGA) not?

1. Not for every single elderly patient.
2. Not a single 10-15 minutes medical consultation.
3. Not a single professional's job.
4. Not a single domain assessment.
5. Not a single point assessment.

GERIATRIC CARE INITIATIVES BY THE GOVERNMENT OF INDIA[16-18]

Government of India has taken several landmark steps to improve the care and welfare of our senior citizens as follows:

1. **National Policy on Older Persons (NPOP)-1999** was formed by the Ministry of Social Justice and Empowerment, Govt. of India to ensure the well-being of older persons. The principal areas of intervention are – financial security, health care and nutrition, shelter, education, welfare, protection of life and property and others. This is implemented through various government schemes and programme like – Indira Gandhi National Old Age Pension Scheme (IGNOAPS), Umbrella Scheme of Atal Vayo Abhyuday Yojana, National Programme for the Health Care of the Elderly (NPHCE) etc.
2. **The Maintenance and Welfare of Parents and Senior Citizens (MWPSC) Act-2007** is a legislation initiated by the Ministry of Social Justice and Empowerment, Govt. of India. It provides the legal framework for ensuring the financial security, welfare and protection of senior citizens (60 years and above) of India.
   - Children or legal heirs who have sufficient means are legally obligated to support elderly parents for their physical and psychological needs.
   - It emphasizes the government's role in providing old-age homes and medical care for the senior citizens.
3. **National Programme for Health Care of the Elderly (NPHCE)-2010-11** was initiated by the Ministry of Health and Family Welfare, Govt. of India to address the health care needs of the elderly.

The objectives of NPHCE are:

- To provide accessible, affordable and high-quality long-term comprehensive and dedicated services to an ageing population.
- Creating a new "architecture" for Ageing: to build a framework to create an enabling environment for "a Society for all Ages".
- To promote the concept of Active and Healthy Ageing.
- Convergence with National Rural Health Mission, AYUSH and other line departments like Ministry of Social Justice and Empowerment.

The components of the program are:

- National Health Mission (NHM) Component to provide Primary and Secondary care service delivery through District Hospitals (DH), Community Health Centres (CHC), Primary Health Centres (PHC) and Subsidiary Health Centres (SHC)/Health & Welfare Centres(HWC).
- Tertiary Component: renamed as "Rastriya Varisth Jan Swasthya Yogana"-2016-17 will provide these services through Regional Geriatric Centres (RGCs) (a total of 19 RGCs in 18 states) and National Centres of Ageing (NCAs) (2 NCAs – one in AIIMS, New Delhi and the second one in Madras Medical College, Chennai).
- Research: A Longitudinal Ageing Study in India (LASI) project-2017-18 is a nationally representative survey of older persons in India and is undertaken through International Institute of Population Sciences (IIPS), Mumbai.

4. **Comprehensive Primary Health Care-Comprehensive Geriatric Assessment (CPHC-CGA)-2023** – CGA has been incorporated into the existing framework of CPHC in the primary care settings by the Ministry of Health and Family Welfare, Govt of India on 30 November 2023.

CGA IN INDIAN PERSPECTIVE[19,20]

There are numerous problems in implementing CGA in a developing country like India. The Ministry of Health and Family Welfare, Government of India in the initial planning has incorporated CGA within the existing framework of Comprehensive Primary Health Care (CPHC) and has published the guidelines for the Centres and Providers of CGA in the Primary Care Settings on 30 November 2023, as follows (the numbers in the brackets represent the currently available centres / staffs):

1) **SHC-HWC** = Subsidiary Health Centre / Health & Wellness Centre (India- 1,30,345 / WB- 8878).
2) **PHC** = Primary Health Centre (India- 23,584 / WB- 907).
3) **UPHC** = Urban Primary Health Centre (India-9062 / WB- 850).
4) **AAM** = Ayushman Arogya Mandirs = (SHC + PHC + UPHC) = (India-1,62,991 / WB-10635).
5) **ASHA (F)** = Accredited Social Health Activist (Educational Standard – X) (India- @7,85,000 / WB- 66,883).
6) **MPW (F/M)** = Multipurpose Workers (Educational Standard – XII). (Trained in malaria control by MO in PHC) (India- F: @2,17,000 / M: @76,000 // WB- F:17,988 / M: 419).
7) **SN** = Staff Nurse (Educational Standard – GNM / Basic B.Sc Nursing) (India- @43,000 / WB- 2075).
8) **CHO** = Community Health Officers (Educational Standard – B. Sc Nursing with an Integrated Certificate in Community Health for Nurses) (India- @1,22,000 / WB- 8,884).
9) **MO** = Medical Officers (Educational Standard – MBBS) in PHC (India- @47,000 / WB- 3205).

The Government's plan for comprehensive healthcare for the elderly has the following components to cover:

1) Cardiovascular Risk Assessment.
2) Nutritional Assessment.
3) Mental Health Assessment.
4) Non-Communicable Disease Management.
5) Oral Health Assessment.
6) Ophthalmic Assessment.

The guidelines on CGA for the Secondary / Tertiary Care Settings from the Ministry of Health and Family Welfare, Govt. of India are yet to be published. However, the problems and necessary steps forward can be as follows:

PROBLEMS

1) Most hospitals, even in teaching hospitals, do not have any dedicated Geriatric unit.
2) Organized multi-disciplinary team (MDT) is non-existent.
3) Inadequate number of trained Geriatricians.
4) Lack of adequate resource allocation.
5) Lack of awareness at every levels.

WAY FORWARD

1) Increase social awareness about Geriatric issues by the professional bodies, media, NGOs and the government.
2) Political awareness and good will is of utmost importance.
3) Development of Specialist Geriatric units in all hospitals, at least up to DH.
4) Geriatric Medicine must be incorporated in to the core curriculum of undergraduate medical (MBBS) and nursing (GNM) syllabus.
5) Increase the number of MD Geriatrics seats across the country.
6) Existing family physicians and other clinicians should be trained in geriatric issues through orientation courses.
7) To produce adequate number of Geriatric Care Givers through proper training.
8) Adequate resource allocation for development of necessary infrastructure and trained personnels.

INDIAN GUIDELINES ON CGA UNDER CPHC

CGA is a multi-disciplinary process where the information captured is used as a basis to plan care and treatment for the elderly with multi-dimensional problems. It includes short-term and long-term goals, follow ups and rehabilitation services. CGA has six dimensions to be addressed as follows:

1) Screening for Geriatric Giants.
2) Socioeconomic status assessment.
3) Comorbidity assessment and Optimisation.
4) Functional Status assessment.
5) Medication Optimisation.
6) Nutritional assessment.

Section B3 of the Community Based Assessment Checklist (CBAC) is specific to the elderly. Risk assessment starts with the completion of this checklist for all the elderly from each village in the Subsidiary Health Centre (SHC) / Health & Wellness Centre (HWC) area by the designated Accredited Social Health Activist (ASHA). This CBAC-B3 has four questions as follows and if the answer to any of these questions is "Yes", then that elderly should be referred to the MPW for starting preliminary assessment as a part of CGA.

Table 1. Community Based Assessment Checklist (CBAC)

Questions	Answers
1. Do you feel unsteady while standing or walking?	Yes / No
2. Are you suffering from any physical disability that restricts your movements?	Yes / No
3. Do you need help from others to perform everyday activities such as eating, getting dressed, grooming, bathing, walking or using the toilet?	Yes / No
4. Do you forget names of your near ones or your own home address?	Yes / No

Table 2. Overview of Components of CPHC-CGA

Sections	Contents under each section	Responsible Person
Section-1: Basic details	A. Registration details B. Identification data of elderly person	MPW (M/F)
Section-2: History taking	A-H: Detailed clinical history (Chief complaints / details of CC / Past history / Drug history / Addiction history / Nutrition history / Family history / Social & Spiritual history / Personal history / Home safety.	MPW (M/F)
Section-3: 10 Minutes Comprehensive Screening	A. Screening for Geriatric syndromes B. Screening for other age-related problems C. Functional assessment.	CHO/SN
Section-4: Physical examination	A. General examination B. Systemic examination	CHO/SN
Section-5: Syndrome specific toolkit for assessment of the problems identified in section-3.	A. Memory loss B. Cognitive impairment C. Screening for depression D. Falls risk assessment E. Incontinence assessment	MO
Section-6: Comprehensive Geriatric Assessment Reports.		CHO/SN/MO

Flow Chart for
Comprehensive Geriatric Assessment (CGA)

ASHA refers an elderly person for CGA, if answer to any question in CBAC-B3 is "Yes".

↓

MPW (M/F) does preliminary assessment by using Sections 1 & 2 of CGA

↓

CHO assesses using Sections 3 & 4 of CGA

↓

MO / Specialist assesses after being referred by CHO, using Sections 5 & 6 of CGA.

Ministry of Health and Family Welfare, Government of India has incorporated CGA within the Comprehensive Primary Health Care (CPHC) module through the existing Primary Health Care network. CGA has six sections to be completed by Multipurpose Workers (MPW), Community Health Officers (CHO) and Medical Officers (MO) / Specialists. The overview of six sections of CGA under CPHC is described in the Table 1).

So the flow chart for Comprehensive Geriatric Assessment under Comprehensive Primary Health Care is described on Table 2:

Who should get priority for CGA? – Frail elderly with one or more "geriatric giants" has the positive "red flag sign" and should get priority for CGA, as follows in the flow chart:

1) Age > 75 years.
2) Needs help with Activities of Daily Living (ADL).
3) Lives alone.
4) History of falls.
5) History of delirium / confusion.
6) History of incontinence.
7) More than two admissions to acute care hospital / year.
8) "Failure to thrive".

In summary, CGA is an assessment tool to help get best help for the elderly as soon as possible.

- CGA tool consists of 6 sections.
- Initial screening is done at sub centre level.
- Commonly used CGA forms are:
  1) Mini-Cog and GP-Cog – for dementia
  2) GDS-4 and GDS-15 – for depression.
  3) Fall risk assessment questionnaire.
  4) Questionnaire for urinary incontinence.
  5) Katz index – for activities of daily living.
  6) Mini nutritional assessment.

CONCLUSION

CGA is the holistic assessment, systematic planned management and ongoing monitoring of the complex and multi-dimensional health problems of the frail elderly. This complex and monumental work is possible only through the co-ordinated and planned actions of all the members of a dedicated multi-disciplinary team (MDT). This is pretty expensive and time-consuming, i.e. resource intensive. In a developing country like India with an elderly population of over 150 million, proper implementation of CGA will need meticulous planning and adequate government funding on an ongoing basis. Private healthcare sectors, Non-Government Organizations (NGOs) and all sections of the society including media, family and friends of the elderly and the elderly themselves have definite roles to play for necessary care of our senior citizens.

Finally, spirituality plays a very important role in the management of the frail elderly. Whether good or bad, "nothing lasts forever in this world" is the bare truth of life. Life is a balance sheet of profits and losses. Along with the vast experience of life, old age comes with a package of deficits and losses, many of which cannot be cured or compensated. Spirituality helps us in developing an appropriate attitude to accept these stark facts of life with a smile and enjoy life till the end.

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Beyond Balance: Multisensory Integration Strategies for Fall Prevention in Ageing Adults

Rahul Garg[1]

Abstract

Falls represent a significant health concern for older adults, with multisensory integration deficits emerging as critical contributors to balance impairments and increased fall risk. This review examines the complex relationship between age-related changes in sensory integration and fall occurrence, exploring evidence-based interventions targeting these processes. Research reveals that ageing affects multisensory processing in context-dependent ways—sometimes enhancing integration for simple tasks while impairing performance for complex spatial-temporal processing. Effective interventions include multisensory balance training that systematically manipulates sensory inputs, environmental modifications that optimize sensory cues, sensory augmentation technologies that provide supplementary feedback, and integrated multicomponent approaches combining multiple evidence-based strategies. Despite promising outcomes, challenges remain in standardizing assessment protocols, understanding neurophysiological mechanisms, and addressing individual variability in sensory profiles. Future research should focus on developing personalized interventions based on comprehensive sensory assessment, investigating neural correlates of successful interventions, and evaluating long-term effectiveness. Addressing these challenges will enhance our ability to prevent falls in multisensory-impaired older adults through targeted sensory integration approaches.

Keywords: *multisensory integration, fall prevention, ageing, balance, sensory impairment, intervention*

INTRODUCTION

Falls represent one of the most serious health concerns for older adults, with approximately one-third of community-dwelling individuals aged 65 and older experiencing a fall each year.[1] Falls are associated with significant adverse outcomes including fractures, traumatic brain injuries, reduced mobility, loss of independence, and increased mortality.[2] The economic burden associated with falls is substantial, encompassing direct medical costs and indirect costs related to long-term disability and reduced quality of life.[3]

The maintenance of balance and postural control is a complex process that relies on the integration of multiple sensory inputs, including visual, vestibular, and somatosensory information.[4] With advancing age, these sensory systems undergo various degenerative changes that can compromise their functional integrity. Beyond isolated sensory impairments, ageing also affects the central integration of multisensory information—a process critical for accurate perception of body position and movement in space.[5]

Recent research has highlighted the importance of multisensory integration (MSI) in balance control and fall prevention.[6] MSI refers to the brain's ability to combine information from different sensory modalities to form a coherent and enhanced perceptual experience. This process is particularly vital for older adults who may experience age-related deterioration in individual sensory systems, necessitating compensatory strategies to maintain balance and prevent falls.[6]

This review aims to synthesize current evidence on the relationship between multisensory integration and falls in older adults, with a particular focus on interventions targeting sensory integration processes for fall prevention. We will examine the neurophysiological basis of age-related changes in sensory

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integration, evaluate the effectiveness of various intervention approaches, and identify gaps in current knowledge and directions for future research.

MULTISENSORY INTEGRATION IN AGING

Neurophysiological Basis of Multisensory Integration

Multisensory integration occurs at multiple levels of the nervous system, from subcortical structures to various cortical regions. The superior colliculus, thalamus, and association cortices serve as key integration centers where inputs from different sensory modalities converge.[7] This integration process follows certain principles, including spatial and temporal congruence, and is subject to both bottom-up sensory-driven mechanisms and top-down cognitive influences.

Neuroimaging studies have revealed that multisensory integration involves a distributed network of brain regions, including the superior temporal sulcus, intraparietal sulcus, insula, and prefrontal cortex.[8] These regions work in concert to integrate information across sensory modalities, forming a unified perceptual representation that guides motor planning and execution, as shown in Figure 1.

Figure 1 illustrates the distributed neural network underlying multisensory integration, showing how sensory-specific regions (visual, auditory, somatosensory, and vestibular cortices) connect to key integration centers including the superior temporal sulcus, intraparietal sulcus, insula, and prefrontal cortex.

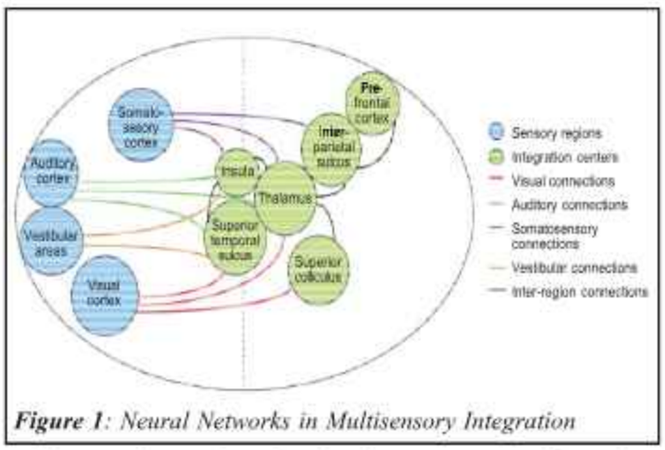

***Figure 1**: Neural Networks in Multisensory Integration*

Age-Related Changes in Sensory Systems

With advancing age, all major sensory systems undergo structural and functional changes that can impact their performance,

Age-Related Changes in Sensory Systems

Sensory system	Structural Changes	Functional Changes 65+ Population	Prevalence in	Impact on Balance
Visual	• Lens opacity (cataracts) • Retinal degeneration • Optic nerve atrophy • Reduced pupil size	• Decreased visual acuity • Reduced contrast sensitivity • Impaired depth perception • Diminished peripheral vision	• Cataracts: 68.3% • Glaucoma: 11.7% • Macular degeneration: 8.9% • Diabetic retinopathy: 4.6%	• Poor spatial navigation • Reduced obstacle detection • Impaired visual-motor coordination • Increased reliance on other senses
Vestibular	• Hair cell loss in semicircular canals • Otoconia displacement • Reduced vestibular nerve fibers • Decreased central processing	• Reduced vestibulo-ocular reflex • Impaired angular motion detection • Decreased postural reflexes • Poor motion perception	• Vestibular dysfunction: 35.4% • BPPV: 17.3% • Vestibular hypofunction: 8.2%	• Dizziness and vertigo • Postural instability • Impaired gaze stabilization • Reduced dynamic balance
Somatosensory	• Peripheral nerve degeneration • Reduced mechano-receptors • Spinal cord changes • Cortical reorganization	• Decreased tactile sensitivity • Reduced proprioception • Impaired vibration sense • Slower nerve conduction	• Peripheral neuropathy: 26.4% • Reduced vibration sense:45% • Joint position errors: 58%	• Poor body awareness • Delayed postural responses • Reduced surface adaptation • Impaired movement control
Auditory	• Hair cell degeneration • Stria vascularis atrophy • Central auditory processing changes • Tympanic membrane stiffening	• Hearing threshold elevation • Reduced frequency discrimination • Poor speech understanding • Diminished spatial hearing	• Hearing loss: 65.5% • Moderate-severe loss: 25.1% • Use hearing aids: 30.2%	• Reduced spatial awareness • Impaired environmental detection • Decreased vigilance • Compensatory head movements

Table 1: Age-Related Changes in Sensory Systems

Notes

- Prevalence data based on community-dwelling older adults
- Multiple sensory impairments occur in 25% of adults >70 years
- Impact severity varies with degree of impairment and compensation strategies
- Synergistic effects when multiple systems are affected

as shown in Table 1.

Visual System: Age-related changes include reduced visual acuity, contrast sensitivity, depth perception, and peripheral vision. Conditions such as cataracts, glaucoma, and macular degeneration further compromise visual function in older adults.[9]

Vestibular System: Ageing is associated with progressive loss of vestibular hair cells, reduced vestibular-ocular reflex gain, and impaired vestibular compensation, leading to dizziness and imbalance.[10]

Somatosensory System: Older adults experience decreased tactile sensitivity, reduced proprioception, and impaired vibration sense due to peripheral nerve degeneration and central changes in somatosensory processing.[11]

Auditory System: Age-related hearing loss (presbycusis) affects approximately 40% of adults over 65, potentially contributing to spatial disorientation and falls.[12,13]

These sensory deficits rarely occur in isolation; rather, older adults often experience impairments across multiple sensory modalities simultaneously. The prevalence of combined sensory impairments increases significantly with age, with up to 25% of individuals over 70 reporting difficulties in two or more sensory domains.[14]

Age-Related Changes in Multisensory Processing

Research on age-related changes in multisensory processing has yielded somewhat paradoxical findings. Some studies report enhanced multisensory integration in older adults compared to younger individuals, while others document impairments in integration processes:

Enhanced Integration: Laurienti *et al* and Peiffer *et al* observed greater multisensory enhancement effects in older adults during simple audiovisual detection tasks, suggesting that seniors may rely more heavily on multisensory cues to compensate for

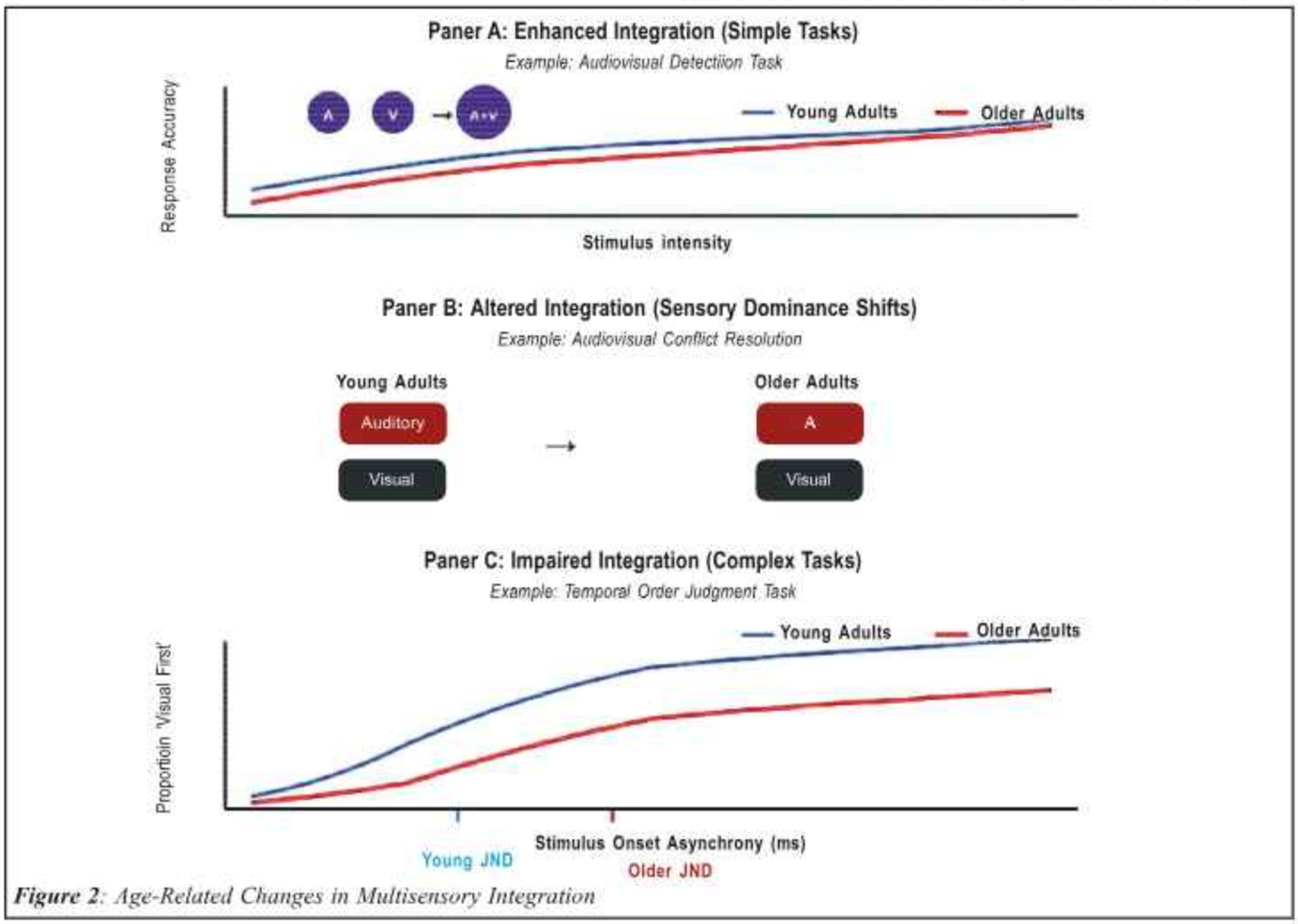

***Figure 2**: Age-Related Changes in Multisensory Integration*

unisensory deficits.[15,16] This phenomenon has been interpreted within the framework of the "inverse effectiveness principle," which points that multisensory gain is inversely related to the effectiveness of the individual sensory inputs. These divergent findings are illustrated in Figure 2, which demonstrates the context-dependent nature of age-related changes in multisensory integration.

Panel A shows enhanced integration effects in older adults for simple detection tasks, while Panel B depicts altered sensory dominance patterns, and Panel C reveals impaired integration for complex temporal processing tasks.

Altered Integration: Other studies have documented qualitative changes in multisensory processing with aging. Diaconescu *et al* found that older adults exhibit altered patterns of sensory dominance, with a shift toward greater visual dominance in audiovisual integration. This change may reflect compensatory mechanisms or alterations in the weighting of sensory inputs with age.[17]

Impaired Integration: Some investigations have revealed deficits in multisensory integration among older adults, particularly for complex tasks requiring rapid processing or precise temporal integration. Setti *et al*. demonstrated that inefficient multisensory processing was associated with increased fall risk in older adults.[18] Similarly, Mahoney *et al* found that impaired visual-somatosensory integration predicted poor balance and falls in community-dwelling seniors.[5]

These divergent findings may be reconciled by considering the context-dependent nature of multisensory integration. Enhanced integration may be observed for simple detection tasks where redundant information across modalities facilitates performance. In contrast, impairments may emerge for more complex tasks requiring precise temporal or spatial integration, particularly under challenging environmental conditions.[19]

Neural Correlates of Age-Related Changes in Multisensory Integration

The neural mechanisms underlying age-related changes in multisensory integration remain incompletely understood. Several theoretical frameworks have been proposed to explain these changes:

Dedifferentiation: The dedifferentiation hypothesis suggests that ageing is associated with decreased neural specialization and increased non-selective activation across brain regions. In the context of multisensory processing, dedifferentiation may lead to less distinct neural representations for different sensory modalities, potentially facilitating integration but reducing precision.[20]

Compensatory Reallocation: According to this perspective, older adults recruit additional neural resources to compensate for age-related declines in sensory processing. This may include increased frontoparietal activation during sensory tasks, reflecting greater top-down modulation of sensory processing.[17]

Changes in Inhibitory Control: Age-related reductions in inhibitory control may affect multisensory integration by altering the balance between excitatory and inhibitory neural processes. Hugenschmidt *et al* found that older adults exhibited impaired suppression of cross-modal inputs during modality-specific attention tasks, suggesting deficits in inhibitory mechanisms that normally shape multisensory interactions.[21]

These neural changes may contribute to alterations in the optimal integration of sensory inputs for balance control, potentially increasing susceptibility to falls when navigating complex environments.

RELATIONSHIP BETWEEN MULTISENSORY INTEGRATION AND FALLS

Evidence Linking Multisensory Integration to Balance and Falls

A growing body of evidence supports the relationship between multisensory integration abilities and balance/fall risk in older adults:

Mahoney et al. conducted a prospective study examining the relationship between multisensory integration and both balance performance and falls in community-dwelling older adults. They found that inefficient visual-somatosensory integration, as measured by a speeded reaction time task, was associated with poorer performance on clinical balance measures and predicted falls over a 12-month follow-up period.[5]

Setti et al. investigated the relationship between audiovisual temporal order judgment—a measure of multisensory temporal processing—and falls in older adults. Their findings indicated that fallers exhibited significantly poorer temporal discrimination thresholds compared to non-fallers, suggesting that impaired multisensory temporal processing may contribute to fall risk.[18]

Zhang et al. conducted a systematic review of studies examining multisensory integration and falls in older adults. They concluded that impaired multisensory processing constitutes an independent risk factor for falls, even after controlling for other established risk factors such as muscle weakness and polypharmacy.[6]

These studies collectively suggest that efficient multisensory integration represents a critical component of balance control and fall prevention in aging populations.

Mechanisms Underlying the Relationship

Several mechanisms may explain how impaired multisensory integration contributes to increased fall risk:

Delayed Postural Responses: Efficient integration of visual, vestibular, and somatosensory information is essential for rapid detection of postural perturbations and timely implementation of corrective strategies. Deficits in multisensory processing may delay these responses, increasing the likelihood of falls when balance is challenged.[22]

Reduced Sensory Reweighting: The ability to adaptively reweight sensory inputs based on their reliability—known as sensory reweighting—is crucial for maintaining balance across varying environmental conditions. Older adults with impaired multisensory integration may exhibit deficits in this dynamic

reweighting process, leading to inappropriate reliance on potentially misleading sensory cues.[23]

Impaired Spatial Orientation: Accurate perception of the body's position in space relies on the integration of inputs from multiple sensory systems. Deficits in this integration process may result in spatial disorientation and impaired navigation abilities, particularly in complex environments with multiple sensory demands.[24]

Cognitive-Motor Interference: Multisensory integration involves both bottom-up sensory processing and top-down cognitive control. Age-related changes in attentional processes and executive function may compromise the efficient allocation of cognitive resources to sensory integration, particularly in dual-task situations that are common in daily activities.[25]

Understanding these mechanisms is essential for developing targeted interventions that address the specific components of multisensory processing most relevant to fall prevention.

SENSORY INTEGRATION APPROACHES FOR FALL PREVENTION

Multisensory Balance Training

Multisensory balance training involves exercises that systematically manipulate sensory inputs to challenge and improve the integration of information across multiple sensory modalities. These interventions typically include:

Sensory Manipulation Exercises: Activities that progressively reduce or alter inputs from specific sensory systems (e.g., standing with eyes closed, on compliant surfaces, or with head movements) to promote adaptive sensory reweighting and enhance reliance on remaining sensory cues.[26]

Dual-Task Training: Combining balance activities with concurrent cognitive tasks to improve the allocation of attentional resources and enhance automatic postural control under divided attention conditions.[27]

Virtual Reality-Based Training: Immersive environments that provide multisensory stimulation and can be systematically manipulated to challenge sensory integration processes in a controlled and engaging manner.[6]

Evidence suggests that multisensory balance training can improve balance performance and reduce fall risk in older adults with sensory impairments. Yoo and Do conducted a scoping review of multisensory balance training programme for unsteady elderly individuals and found that these interventions were associated with improvements in static and dynamic balance, functional mobility, and reduced fear of falling. The authors noted that programme incorporating progressive challenge to multiple sensory systems yielded the most favorable outcomes.[26]

Environmental Modifications

Environmental modifications aim to optimize sensory cues in the living environment to compensate for age-related sensory deficits and facilitate accurate perception of spatial relationships. These approaches include:

Enhanced Visual Cues: Improving home lighting, increasing color contrast for critical environmental features (e.g., edges of stairs), and reducing visual clutter to enhance visual processing and spatial orientation.[28]

Tactile Cues: Installing textured flooring at transition areas, handrails with tactile indicators, and other tactile landmarks to provide supplementary somatosensory information for navigation and postural control.[29]

Acoustic Modifications: Reducing background noise and reverberation, and incorporating auditory cues for spatial orientation to support individuals with hearing impairments.[30]

Environmental modifications have shown promise in reducing fall risk, particularly when tailored to the specific sensory profiles of individual older adults. Eilertsen *et al* found that improvements in home lighting were associated with better performance in activities of daily living and reduced fall risk among older adults with visual impairments[28]. Similarly, Haanes reported that multisensory environmental adaptations, including enhanced visual and tactile cues, contributed to improved mobility and reduced falls in community-dwelling seniors.[29]

Sensory Augmentation and Substitution

Sensory augmentation and substitution technologies provide supplementary or alternative sensory information to compensate for impaired sensory systems:

Balance-Enhancing Insoles: Footwear with textured insoles or subtle vibratory components that enhance somatosensory feedback from the feet, improving balance control in individuals with peripheral neuropathy or reduced plantar sensitivity.[4]

Vibrotactile Feedback Systems: Wearable devices that provide tactile cues based on body sway or orientation, offering real-time feedback to guide postural adjustments.[10]

Auditory Augmentation Devices: Hearing aids and cochlear implants that not only improve communication but also enhance spatial orientation and awareness through improved auditory processing.[30,31]

Research on sensory augmentation technologies for fall prevention has yielded promising results. Francis *et al* reported that cochlear implantation in older adults with severe hearing loss was associated with improvements in balance confidence and reduced fall risk, highlighting the importance of auditory information for spatial orientation and postural control[31]. Similarly, studies of vibrotactile feedback systems have demonstrated improvements in balance performance and reduced sway in older adults with sensory impairments.[10]

Integrated Multicomponent Approaches

Recognizing the multifactorial nature of falls, integrated approaches combine sensory integration training with other evidence-based fall prevention strategies:

Exercise Programme with Sensory Components: Comprehensive exercise interventions that incorporate strength,

flexibility, and endurance training alongside specific sensory integration exercises to address multiple fall risk factors simultaneously.[32]

Multidisciplinary Assessment and Intervention: Collaborative approaches involving various healthcare professionals (e.g., physical therapists, audiologists, optometrists) to assess and address multiple sensory impairments and their impact on functional mobility.[29]

Education and Self-Management: Programme that empower older adults with knowledge about sensory changes, strategies for optimizing sensory processing, and techniques for navigating challenging environments safely.[27]

Integrated approaches have shown particular promise for fall prevention in multisensory-impaired older adults. Bates *et al* evaluated a workshop-based programme teaching home exercises that incorporated sensory integration components and found significant reductions in falls among participants compared to control groups.[32] Maneemai *et al* demonstrated that comprehensive sensory integration programs combining assessment, targeted interventions, and education yielded improvements in balance confidence, mobility, and quality of life while reducing fall incidence,[27] as illustrated in Figure 3.

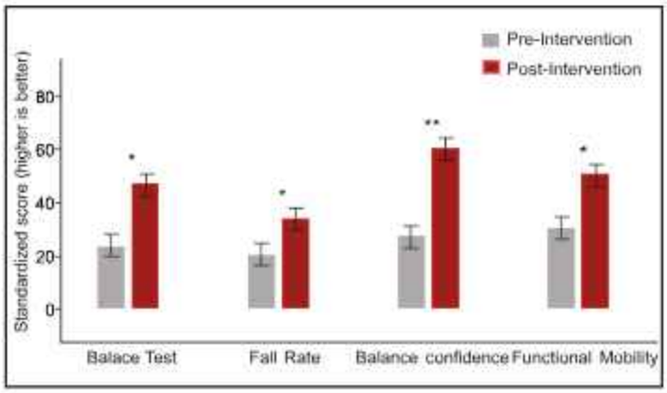

***Figure 3**: Comaprison of Pre/Post intervention scores across different measures*

The effectiveness of these integrated approaches is demonstrated, which shows significant improvements across multiple outcome measures following sensory integration interventions.

Figure 4 provides a comprehensive overview of evidence-based sensory integration interventions for fall prevention.

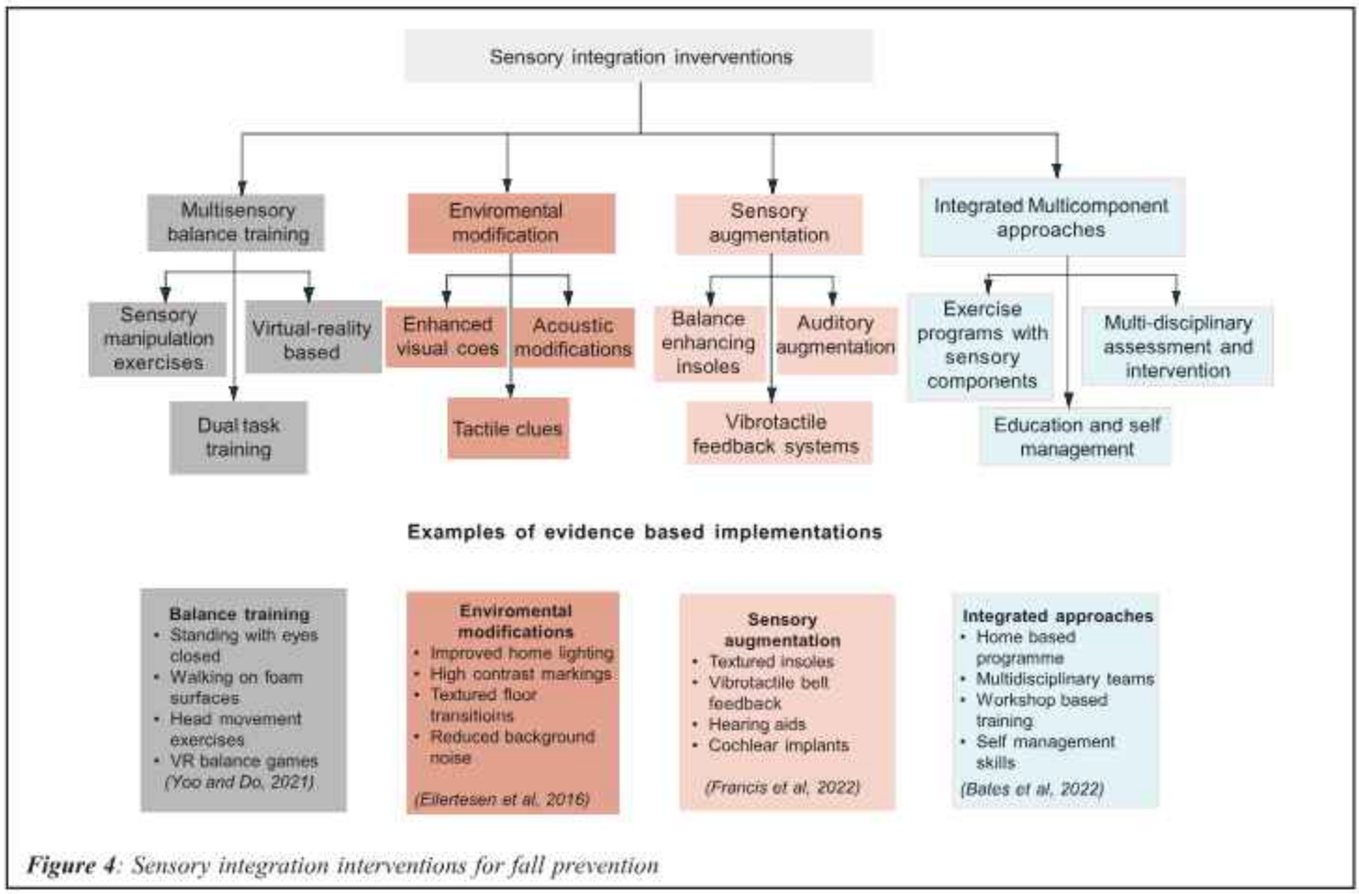

***Figure 4**: Sensory integration interventions for fall prevention*

CLINICAL IMPLICATIONS AND IMPLEMENTATION CONSIDERATIONS

Assessment of Multisensory Integration

Effective implementation of sensory integration approaches requires appropriate assessment tools to identify specific deficits and monitor progress, as mentioned in Table 2.

Clinical Measures: Tests such as the Sensory Organization Test, Clinical Test of Sensory Integration in Balance, and computerized dynamic posturography provide quantitative assessment of sensory contributions to balance control.[33]

Table 2: Assessment Tools for Multisensory Integration

Clinical Utility Ratings

- High: Easily implemented in most clinical settings
- Moderate: Implementation possible but with some constraints
- Low: Primarily research tools with limited clinical applicability

Abbreviations: ICC = Intraclass Correlation Coefficient; MDC = Minimal Detectable Change; SOT = Sensory Organization Test

Assessment of Multisensory Integration

Assessment Tool	Domain Assessed	Administration Time	Equipment Needed	Psychometric Properties	Clinical Utility
Sensory Organization Test (SOT)	Sensory contributions to balance; sensory reweighting capacity	15-20 minutes	Computerized dynamic posturography platform	High test-retest reliability (ICC=0.83-0.94); Good sensitivity for fall prediction	High - gold standard but limited by equipment cost and availability
Clinical Test of Sensory Integration in Balance (CTSIB)	Visual, vestibular, and somatosensory contributions to balance	10-15 minutes	Foam pad, stopwatch, visual conflict dome	Moderate reliability (ICC=0.75-0.86); Correlation with SOT (r=0.63-0.70)	High - accessible clinical alternative to SOT
Timed Up and Go (with sensory conditions)	Functional mobility under varied sensory conditions	5-10 minutes	Stopwatch, chair, walking course, sensory manipulation items	High reliability (ICC>0.90); Good ecological validity	High - quick, functional assessment with minimal equipment
Functional Gait Assessment	Dynamic balance during walking with sensory challenges	10-15 minutes	Walkway, obstacles, stopwatch	Excellent reliability (ICC=0.93); MDC=4.2 points	Moderate - good functional relevance but requires space
Visual-Somatosensory Integration Task	Cross-modal processing speed and accuracy	15-20 minutes	Computer with specialized software, response box	Test-retest reliability (r=0.78); Correlates with balance measures (r=0.45-0.60)	Low - primarily research tool, limited clinical availability
Temporal Order Judgment Task	Audiovisual temporal processing	15-20 minutes	Computer with specialized software, headphones	Moderate reliability (ICC=0.69-0.78); Discriminates fallers from non-fallers	Low - primarily research tool, technical expertise required
Multisensory Processing Assessment	Integration across multiple sensory modalities; sensory weighting	30-40 minutes	Specialized equipment for sensory stimulation and recording	Good validity (criterion validity r=0.72-0.85); Sensitive to age-related changes	Low - comprehensive but requires specialized laboratory setup
Balance Evaluation Systems Test (BESTest)	Six balance control systems including sensory orientation	30-35 minutes	Foam pad, incline ramp, obstacles, stopwatch	Excellent reliability (ICC>0.90); High sensitivity and specificity for fall risk	Moderate - comprehensive but time-consuming

Functional Assessments: Measures such as the Timed Up and Go test under various sensory conditions, the Functional Gait Assessment, and obstacle navigation tasks evaluate sensory integration in functionally relevant contexts.[34]

Psychophysical Tasks: Reaction time tasks, temporal order judgment, and other experimental paradigms assess specific aspects of multisensory processing that may not be captured by clinical balance measures.[35]

Comprehensive assessment should include evaluation of individual sensory systems as well as their integration, considering both basic sensory function (e.g., visual acuity, proprioception) and more complex integrative processes (e.g., sensory reweighting, resolution of sensory conflicts).

Tailoring Interventions to Individual Needs

Given the heterogeneity of sensory profiles among older adults, interventions should be tailored to individual patterns of sensory function and integration:

Sensory Profiling: Systematic assessment of strengths and weaknesses across sensory modalities to identify specific targets for intervention and guide selection of appropriate strategies[11].

Consideration of Cognitive Status: Adaptation of intervention approaches based on cognitive abilities, with simplified strategies for individuals with cognitive impairment and more complex challenges for those with intact cognition.[36]

Progressive Challenge: Gradual advancement of difficulty based on individual performance to optimize learning while maintaining safety and engagement.[37]

Mahoney et al. found that physical activity level moderated the relationship between visual-somatosensory integration and balance performance, suggesting that intervention approaches may need to be tailored based on both sensory profiles and overall physical function.[38]

Figure 5 presents a clinical decision-making flowchart for implementing personalized sensory integration interventions.

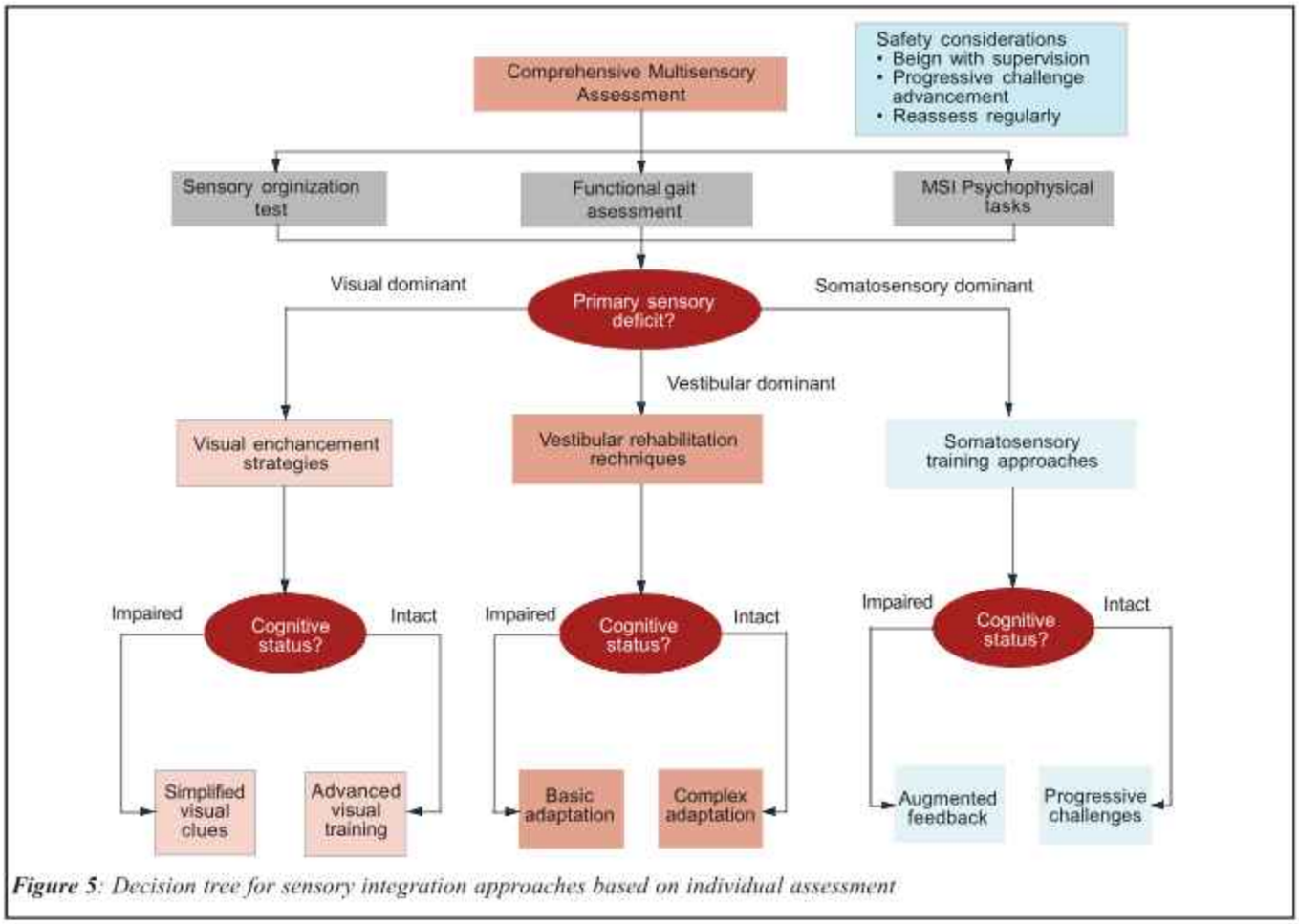

***Figure 5**: Decision tree for sensory integration approaches based on individual assessment*

Implementation Challenges and Solutions

Several challenges may impact the implementation of sensory integration approaches in clinical and community settings:

Resource Limitations: Some assessment and intervention approaches require specialized equipment or expertise that may not be widely available. Solutions include developing simplified assessment protocols suitable for primary care settings and training non-specialist providers to implement basic sensory integration exercises.

Adherence Issues: Older adults may struggle to maintain participation in interventions, particularly those requiring regular attendance at facility-based programme. Home-based programme with intermittent supervision, telehealth delivery models, and incorporation of enjoyable, socially engaging activities may improve adherence.

Safety Considerations: Sensory manipulation exercises inherently challenge balance and must be implemented with appropriate safety precautions. Progressive advancement of difficulty, proper supervision, and implementation in controlled environments with appropriate support can minimize risk while maintaining effectiveness.

Community-based implementations have shown promise for overcoming these challenges. Bates *et al* demonstrated that workshop-based instruction in home exercises incorporating sensory challenges was both feasible and effective for community-dwelling older adults.[32] Similarly, Haanes described successful implementation of multidisciplinary sensory management approaches in community settings using existing resources and collaborative care models.[29]

FUTURE DIRECTIONS AND RESEARCH NEEDS

Standardization of Assessment and Intervention Protocols

Current research on sensory integration for fall prevention is limited by heterogeneity in assessment methods and intervention protocols, making comparison across studies challenging. Future work should focus on:

Development of Standardized Assessment Batteries: Validation of comprehensive assessment tools that evaluate multiple dimensions of sensory integration in a consistent manner across studies and clinical settings.

Consensus Guidelines: Establishment of evidence-based recommendations regarding optimal parameters for sensory integration interventions, including frequency, intensity, duration, and progression strategies.

Implementation Frameworks: Development of structured frameworks to guide translation of research findings into clinical practice across various healthcare settings.

Investigation of Neurophysiological Mechanisms

A deeper understanding of the neural mechanisms underlying successful sensory integration interventions could inform more targeted and effective approaches:

Neuroimaging Studies: Investigations of neural activation patterns before and after sensory integration training to identify key brain regions and networks involved in improvement.

Biomarker Development: Identification of neurophysiological markers that predict responsiveness to different intervention approaches, enabling more personalized treatment selection.

Neuromodulation Approaches: Exploration of non-invasive brain stimulation techniques as adjuncts to behavioral interventions for enhancing neuroplasticity and accelerating improvements in sensory integration.

Technological Innovations

Emerging technologies offer exciting possibilities for advancing sensory integration approaches:

Wearable Monitoring Systems: Development of unobtrusive devices that can continuously monitor aspects of sensory integration in real-world environments, providing ecologically valid assessment and real-time feedback.

Augmented Reality Applications: Creation of training environments that systematically manipulate sensory inputs while maintaining engagement and relevance to daily activities.

Artificial Intelligence Algorithms: Development of predictive models that can identify patterns of sensory integration deficits associated with increased fall risk and guide preventive interventions.

Long-Term Effectiveness and Maintenance

Most current studies focus on relatively short-term outcomes, with limited information on long-term retention of improvements and strategies for maintaining benefits:

Extended Follow-Up Studies: Investigation of the durability of improvements in sensory integration and fall risk reduction over extended time periods (≥2 years).

Maintenance Strategies: Development and evaluation of approaches for sustaining improvements, such as booster sessions, self-monitoring tools, or technology-assisted maintenance programme.

Cost-Effectiveness Analyses: Comprehensive evaluation of the economic impact of sensory integration interventions, considering both direct healthcare costs and broader societal impacts.

CONCLUSION

Falls threaten older adults' health and independence, especially those with multisensory impairments. Research confirms multisensory integration's crucial role in balance control. Effective fall prevention includes multisensory balance training, environmental adaptations, sensory augmentation technologies, and integrated approaches—all tailored to individual sensory profiles. Challenges remain: standardized assessment tools are needed,

neurophysiological mechanisms require further study, and long-term effectiveness data is limited. As our population ages, addressing sensory integration for fall prevention grows increasingly important. By combining insights from neuroscience, rehabilitation, and gerontology, we can develop better strategies to enhance balance, reduce falls, and support independence among older adults.

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Health Benefits of Nature Therapy, as a Prescription for Elderly Population: A Systematic Review

Sachin Desai[1]

Abstract

***Background**: The insights of Nature and its beneficial effects on health and wellbeing have been documented in history as early as 2500 years ago.[1] As early as 16th century, Swiss-German physician declared about that 'The art of healing comes from nature, not from the physician alone.[1] These insights have made researchers to work extensively on identifying the benefits, of being amidst nature. Research conducted in Japan and South East Asian countries highlights benefits for psychological and physiological systems with practices associated with Nature, supporting the preventive health care approach incorporated in their traditional practices. Researchers claim that health benefits ranging from Cognitive stimulation, boosting the immune system, Cardiovascular disease prevention, Respiratory allergies, mood and stress related disorders and sympathetic overactivity relaxation can be seen by being amidst nature.*

***Rationale of the study**: With immense therapeutic benefits, and limited articles documented on Nature therapy, in all age groups, this article describes the health benefits and steps of conducting a literature review on nature therapy through the 6 articles screened and filtered out of the 32 articles reviewed from the year 2008 to 2023.*

***Objective of this article**: To understand the health benefits of Nature therapy on older adults through a systematic review.*

***Data sources**: The data search was conducted by reviewing articles published in two databases, namely PubMed Central and Cross Ref databases and critiquing the articles chosen for the discussion and procedure has been expressed as per PRISMA framework.*

***Study eligibility criteria:** elderly, nature therapy and published in the above two databases.*

***Participants involved**: elderly above 60 years*

***Synthesis methods**: The findings from the articles, have been depicted and documented in a tabular column, with details expressed in terms of Year of publication, Author, Geographic location, Population studied, Type of study, Variables assessed and Observed outcomes.*

***Results:** On exposure to nature therapy there were significant improvement and strengthening of the immunological responses, reduction in depression levels, reduction in heart rate and heart rate variability among elderly following nature therapy.*

***Conclusions:** With nature being prescribed in Japan, Canada, New Zealand and the UK, it would definitely be a safer and an economically cost-effective prescription to morbidities among the elderly population worldwide.*

***Key words:** Health benefits, Nature therapy, Older adults.*

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INTRODUCTION

'Shin Rin Yoku'[2] is a traditional practice followed in Japan, which involves immersing oneself amidst the nature by sinking the five

senses mindfully. This technique has shown immense therapeutic health benefits on physiological and psychological systems associated with its practice.

Nature therapy is defined as a set of practices, aimed at achieving 'preventive medical effects' through exposure to nature that render a state of physiological relaxation and boost the weakened immune responses and prevent diseases. It includes Mindful walks, Gardening, Outdoor meditation or Yoga, Horticulture therapy etc.

The immense health benefits of nature therapy (Shin Rin Yoku)[2] are complimentary (supportive) to the Kaplans attention restorative hypothesis (1989)[3] and Ulrich's stress reduction (1991)[4] and Kellert and Wilsons Biophilia hypothesis (1993)[5]

Rationale, why this review: Non-pharmacological interventions[6] in the management of dementia care, such as multisensory stimulation, nature therapy etc have been recommended by the National Institute for Health Care and Excellence (NICE)[7] as alternative first-line treatments in Dementia care (Dementia, N.I.C.E., 2006). With an intention to understand, critique and synthesize information from the reviewed articles with detailed interventions done between year 2008 to year 2023, on nature therapy and its health benefits, this review of literature was undertaken, through the two databases search.

Attention restoration, Stress reduction and Biophilia hypothesis: Health benefits have been demonstrated through these three concepts. The attention restoration proposes in which restoration occurs in the environment that involve four components: Being away, Extent or coherence, Fascination and compatibility.[3] Restoration occurs in geographical distancing from one's current living environment, routine and situations and substituting this by nature therapy, have shown immense health benefits. Continued attention plays an important role in human information processing, its fatigue has high reaching consequences. Being amidst natural environments have shown immense benefits of stress reduction and attention restoration.[4] Wilson calls biophilia "innate tendency to focus on life and lifelike processes",[5] "innate emotional affiliation of human beings to other living organisms"[5] or "inborn affinity human beings have for other forms of life, an affiliation evoked, according to circumstances, by pleasure, or a sense of security, or awe, or even fascination blended with revulsion".[5]

Authors, poets and philosophers have long held that exposure to nature have produced restorative benefits and tested empirically to show benefits related to cognitive, emotional and physical wellbeing and optimum performance.[8]

Definition of health: Health, as defined by the World Health Organization (WHO),[9] is a state of complete physical, mental, social wellbeing and not merely an absence of disease or infirmity and an ability to lead an economically and socially productive life.

Wellbeing: Wellbeing of an individual[10] has a subjective and an objective component. The subjective component as expressed by an individual is the 'Quality of Life', and the objective component relate to the 'standard of living' or 'Level of living'.

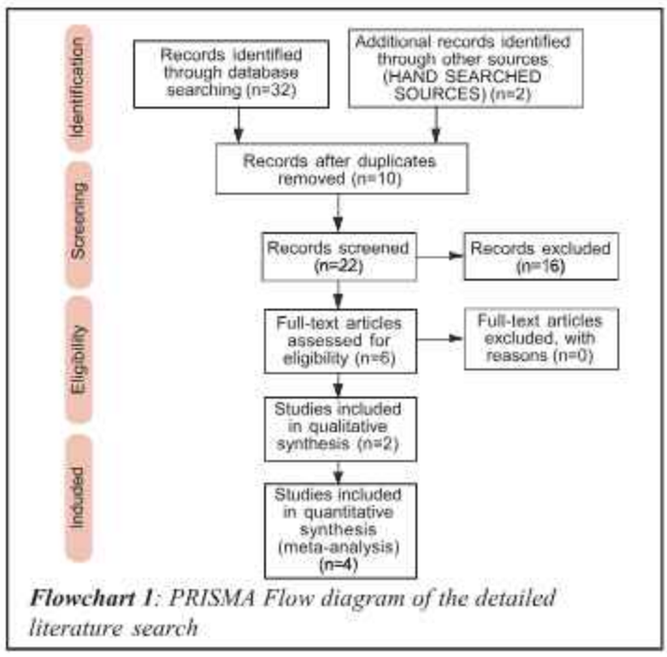
Objective of the review: To understand the health benefits of Nature therapy on older adults through a systematic review, conducted by reviewing articles published in two databases, namely PubMed Central and Cross Ref databases and critique the articles chosen for the discussion and procedure has been expressed as per PRISMA framework[11] and generate an evidence for confirming the findings mentioned in the research question.

METHODOLOGY

A systematic review was conducted from papers published from the year 2008 to 2017 in two electronic web databases namely PubMed and Cross Ref databases. The articles were selected based on the above three key words, with the above practice performed on older adults in various geographic locations around the globe.

Search Strategies, How the articles were chosen: The following parameters were kept in mind to assess the details in the selection of the study. The study statement was to assess the health benefits among older adults through nature therapy interventions like forest walking, forest bathing etc and the changes in the cognitive, emotional and physical wellbeing among the participants were documented. The study designs were both qualitative and quantitative type of studies. Out of the 32 articles screened as per the PICO Guidelines,[12] 6 fulfilled the inclusion criteria amongst which four articles were quantitative studies with an intervention and two were qualitative in nature.

Selection process, detailed description: The details of the literature search have been tabulated below as per the PRISMA flow-diagram done in PubMed and Cross Ref Databases (Flowchart 1). The details of the 6 articles reviewed have been depicted in (Table 1).



***Flowchart 1**: PRISMA Flow diagram of the detailed literature search*

Table 1: Brief Summary, study variables and the results of the articles reviewed from the databases.

Year of publication	Author	Geographic location	Population studied	Type of study	Variables assessed	Observed outcomes
2008	Li.Q[13]	Japan	35-60 years of age (n=12)	Quantitative Interventional study	NK Cell activity, Immununological enzyme levels	Strengthens Immunological enzymes and Natural killer cell activity.
2010	McCaffey[14]	USA	71years mean age (n=40)	Qualitative study	Depression in older adults assessment	Geriatric depression scale scores decreased
2015	Igarashi.M[15]	Japan	46-65years of age (n=17)	Quantitative interventional Study	Heart rate and Heart rate variability and mood	Decrease in Heart rate and sympathetic overactivity and improved mood states
2015	Ohtsuka, Y[16]	Japan	66.8 years mean age (n=48)	Quantitative longitudinal interventional study. Diabetes	Blood glucose levels in Type II	Decreased blood sugar levels
2015	Song, C[17]	Japan	58-68 years of age (n=20)	Quantitative Interventional Study	Heart rate, Heart rate variability assessment	Decrease in Heart rate and sympathetic overactivity
2017	Chun, M.H[18]	Korea	36-79 years age range (n=59)	Qualitative study	Depression and anxiety symptoms in dementia	Decline in depression and anxiety scale scores
2023	Meijing Xu[19]	China	Older adults above 60 years	Quantitative Interventional study	Depression among elderly	Reduction in the depression symptoms

EVIDENCE SYNTHESIS METHODS

Critical evaluation of the qualitative studies:

Out of the six studies reviewed within the selected timeframe and key words searched, four belonged to quantitative study designs and two qualitative studies.

Strengths: The qualitative studies reviewed had a comparison among the pre and a post-test questionnaire score. Exposure to nature stimulated the multisensory components and this helped in better cognitive, emotional and physical wellbeing which were documented by scores of the respective evaluation questionnaires in the study subjects.

The studies chosen matched the objective of the assignment. The older adults were included and the evaluation on them have been documented. The interventions done, to monitor psychological parameters, included screening for depression and mood fluctuations measured and documented before and after the nature therapy intervention are accurately done. The chosen methods fit into the methodology.

Weaknesses: In all the studies, the findings documented and responses to the variables are subjective to the person interviewed, if it has an open-ended questionnaire and the answers documented can deviate from the topic, so having a closed ended questionnaire have to be followed in data collection. By doing so we limit the thinking capabilities and originality in the answers can be masked.

Few gaps: Choosing an appropriate questionnaire, type of answers to the questionnaire, so that uniformity can be achieved in responses for the questions asked.

Challenges involved: Choosing studies with an appropriate questionnaire for the scale variables, will limit original answers from those interviewed. This was the challenge identified.

Amongst the studies chosen for review, the methodology in all the articles is contextual and has involved the older adults with dementia.

Regarding Scaling up of these projects to many variables could be challenging and could cause fatigue to the participant due to limited attention span due to the ageing process among the People living with dementia.

Most important challenge during literature search: Access to the journal articles is limited to some databases and hence it is difficult to access them, unless purchased by our respective university through which we can get permission for access.

RESULTS

Critical evaluation of the quantitative studies

Strengths: The Quantitative interventions included the Randomized controlled trial study design, with interventional arms and control arms receiving the intervention through proper blinding procedure to avoid bias made by the participant, interviewer and the observer. The studies chosen matched the objective of the assignment. The inclusion criteria of people belonging to adults and older adults have been documented. The interventions done, to monitor physiological parameters due to sympathetic overactivity, namely: Heart rate, heart rate variability and mood fluctuations measured and documented before and after the nature therapy intervention. The chosen methods fit into the methodology.

Weaknesses: In all the studies, representativeness of the findings to the whole population could be difficult due to small number of participants chosen for the studies. This is because of

the limited sample size, chosen for the intervention in the review articles.

Few gaps had to be addressed which were regarding the uniformity in the time exposure to nature therapy session and performing the procedure during the same time of the day, on all days. Another weakness was regarding dissimilarity in the Nature therapy intervention type. Few had nature walks session, few did perform forest bathing which could have brought about dissimilarity in the exposure time to nature, thus variation in the results is anticipated.

Challenges involved: Choosing studies with an appropriate sample size for identifying the articles for review, was the challenge identified. Amongst the studies chosen for review, the methodology in all the articles is contextual and has involved the older adults with dementia.

Scaling of the review articles studied (documented) in this article:

The articles reviewed suggest that the interventions performed in them, provide a concrete evidence on health benefits of nature therapy and these health benefits documented have been proved and confirmed by Ulrich's stress reduction hypothesis and Kaplan's Attention restorative Hypothesis and Kellert's and Wilson's Biophilia hypothesis.

Regarding Scaling up of these projects to a larger geographic area, could be challenging.

The qualitative articles are meso-scale and so are the quantitative articles. Limited to one setting and a fair number of participants involved in the study.

Regarding efforts to involve people living with dementia for qualitative studies: Out of the six studies reviewed, the two qualitative studies. The two qualitative studies first from Japan (Chun 2017)[18] and second from USA (McCaffey 2010),[14] have involved the people living with dementia. The decline in the scores of the geriatric depression scales and mood fluctuations have been documented following Nature therapy intervention. Forgetfulness, consent for involving people with moderate to severe cognitive impairment. Predesigned, pretested and a Semi-structed interview through validated scales for assessment, makes them robust studies.

Regarding efforts to involve people living with dementia for quantitative studies:

All the four quantitative articles chosen have a robust study design and a detailed methodology.

With minimal bias due to appropriate blinding techniques followed during the interview, makes them good research articles.

Discussion: Discussion of relevance of the Quantitative studies: Out of the six studies reviewed, the four quantitative studies, there were observed decline in the Heart rate, Heartrate variability and decline in mood fluctuations. The four quantitative studies have involved the people living with dementia. The decline in the Heart rate, Heart rate variability and immunological parameters and improved NK Cells number and activity have been documented following Nature therapy intervention.

Discussion of relevance of the Qualitative studies:

The interventions done on the study participants showed significant improvement following a nature therapy intervention. The psychological parameters which were monitored included screening for depression and mood fluctuations, before and after the nature therapy intervention, have been accurately monitored and documented.

Implications of the review: With advanced search options of searching an article by key words, author name, title of the article and region of research done we can limit our search to few articles. Furthermore, we can screen the required articles according to PICO guidelines and further more represent our article search through the PRISMA framework. Critique and evidence synthesis help us document the findings in a systematic manner.

Researchers can follow this guideline for a detailed literature search for the research projects and for dissertations.

By doing the review of the above six articles, we have been able to document, synthesize and critically evaluate the process and article findings with respect to similarity or differences related to the study methodology, interventions involved and outcome measured through various measurement tools and indicators. The scales with semi structured questionnaires help in generating the details of the interview without generating a interviewer bias.

The health benefits have been measured and documented through quantitative and qualitative methods and measurement tools.

Implications for policy and practice: By performing a review of the above articles the following therapeutic benefit of nature therapy could be implemented in practice and could have immense benefits to the older adults.

CONCLUSION

This systematic review, done in two research databases, with key words and guidelines according to the PICO, represented through PRISMA guidelines and a proper evidence synthesis will help critique, analyse, compile, confirm and evaluate the health benefits of nature therapy as per the objectives stated at the beginning of the review.

Recommendations: With studies in the rest of the world documenting the health benefits of being amidst nature, it could definitely be a recommendation for practioners to recommend Nature therapy as a Non-Pharmacological intervention in older adults as an alternative method of managing health issues.

In Indian context, implementing the above method could take a few years more, as there are very limited studies done on this topic and very few research articles even though we have been experiencing nature and its health benefits every day.

With limited scientific papers on this topic, it would definitely be an area of research in India in the days to come and would be a scientific method of staying healthy. Implementing it as a policy would require strong evidence from India to implement it in the national policy as an alternative tool for healthy ageing. In days to

come it could also be a prescription for older adults and mother nature as always would heal us, like she has been doing it since evolution.

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Human Microbiome Variations and Dysbiosis in the Aged Indian Population: Implications and Interventions

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Abstract

The human gut microbiome plays a pivotal role in metabolic, immunological, and neurological health, with its composition undergoing marked shifts in aged populations. In India, these shifts are strongly influenced by diverse dietary patterns, regional ecosystems, and traditional lifestyles, often resulting in dysbiosis—a microbial imbalance associated with chronic diseases. This review synthesizes current evidence on microbial alterations among elderly Indians, analyses region- and culture-specific determinants of dysbiosis, and evaluates targeted prebiotic and probiotic interventions to restore gut homeostasis. By integrating traditional dietary wisdom with modern microbiome science, we propose strategies to promote healthy aging in India's rapidly expanding elderly population.

Keywords: *Geriatric microbiome, Indian elderly, gut dysbiosis, probiotics, prebiotics, Ayurveda, microbial diversity, healthy ageing*

INTRODUCTION

India's elderly population is projected to exceed 300 million by 2050. With increasing longevity comes a growing burden of age-associated disorders, many mechanistically linked to gut microbiome dysregulation.[1,2] Unlike Western cohorts, the Indian gut microbiome is shaped by dietary heterogeneity, Ayurvedic body-type classifications (Prakriti—traditional constitutional types), extensive biodiversity, and habitual consumption of fermented foods.[2,3] Understanding these intrinsic differences is essential for designing culturally relevant, precision microbiome interventions to support healthy ageing.

MICROBIOME VARIATIONS IN ELDERLY INDIANS

Age-related transformations in the gut microbiome of Indian elders manifest as pronounced declines in overall microbial diversity and shifts in the abundance of key bacterial taxa.[1,3,4] Notably, short-chain fatty acid (SCFA)-producing bacteria, such as Faecalibacterium prausnitzii and Roseburia, diminish with age, while pro-inflammatory genera, including Enterobacteriaceae, increase.[1,3] The landmark familial study from Maharashtra revealed that elderly participants exhibited depleted SCFA producers alongside a higher prevalence of potentially pathogenic species, indicating a predisposition toward dysbiosis and systemic inflammation.[1,5]

Regional differences further modulate these patterns. Rural and tribal populations retain greater microbial diversity, with higher proportions of Firmicutes and diet-adapted unique species—attributes linked to better metabolic and immune markers.[1,3,6] In contrast, urban elders exposed to Westernized diets display reduced diversity, greater inter-individual variation, and loss of distinctive taxa.[1,7]

Indian microbiome research has identified five distinct enterotypes—clusters of gut microbial community structures—exceeding the four commonly reported globally, likely reflecting the country's heterogeneous diets, Ayurvedic constitutional diversity, and varied microbial exposures.[2,7] Ayurvedic phenotyping offers additional insights: Pitta Prakriti individuals tend toward microbial profiles enriched for Bacteroidetes and certain Proteobacteria, taxa associated with elevated inflammatory potential.[4] Remarkably, up to 27% of bacterial isolates from aged Indians represent potentially novel or rare species, underscoring the unique and underexplored biodiversity of the Indian gut ecosystem.[2,7]

MICROBIAL DYSBIOSIS AND ITS CONSEQUENCES

In elderly Indians, dysbiosis often presents as diminished microbial richness alongside an over-representation of pro-inflammatory bacteria and depletion of beneficial SCFA producers including F. prausnitzii.[3,5] This imbalance compromises epithelial barrier integrity, increasing intestinal permeability (leaky gut) and facilitating lipopolysaccharide (LPS) translocation into the

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circulation.[5] The resulting endotoxemia drives chronic low-grade inflammation (inflammaging), a recognised driver of age-related disease. SCFAs—acetate, propionate, and butyrate not only fuel colonocytes but also modulate immune responses via G protein-coupled receptors and suppress NF-κB-mediated inflammatory pathways.[5] Loss of SCFA producers disrupts these protective functions. Mechanistic links between dysbiosis and age-related conditions are well established: impaired barrier function exacerbates insulin resistance in type 2 diabetes, endotoxemia promotes atherogenesis in cardiovascular disease, and gut-derived inflammatory mediators contribute to neurodegeneration via the microbiota-gut-brain axis.[5,6]

Gut dysbiosis is further implicated in sarcopenia through catabolic signaling and reduced nutrient absorption, while contributing to gastrointestinal disorders such as constipation and irritable bowel syndrome.[5,6] Thus, dysbiosis serves as a pathological hub connecting microbial imbalance to metabolic, cardiovascular, cognitive, and musculoskeletal decline. Also, In elderly populations, gut microbiome composition shows gender-specific patterns, with postmenopausal women experiencing pronounced shifts due to declining estrogen levels. These hormonal changes, coupled with dietary and lifestyle transitions, can reduce microbial diversity, alter short-chain fatty acid production, and increase susceptibility to metabolic and inflammatory disorders.[8]

Physical inactivity in late life is consistently linked to lower gut microbial diversity and fewer SCFA producers, while structured exercise tends to enrich butyrate-producing taxa and improve SCFA levels—mechanisms relevant to bowel motility, metabolic health, and inflammation in elders.[8,9] The progressive decline in circadian rhythm associated with ageing may exert significant effects on the gut microbiome, altering its composition, diversity and metabolic functions.[10] To counteract age-related disruption of microbial–circadian synchrony, strategies such as timed feeding, light exposure optimization, and targeted probiotic or dietary interventions may help restore diurnal microbiota rhythms and support healthy aging.

Chronic medications can cause remarkable alterations in gut microbiota composition further leading to dysbiosis. Antibiotics, even when used occasionally, can reduce the population of beneficial taxa such as Bifidobacterium and Lactobacillus, while promoting the growth of opportunistic pathogens.[11] Drugs such as antibiotics, proton-pump inhibitors, metformin, NSAIDs, statins, and psychotropics can disrupt microbial diversity, alter the abundance of beneficial and opportunistic taxa, and impact metabolic, immune, and gut barrier functions. These alterations often called as drug-induced dysbiosis may contribute to systemic, gastrointestinal, metabolic side effects.[12] Metformin, a widely used antidiabetic drug, modulates gut microbiota by enriching SCFA-producing bacteria like Akkermansia muciniphila and Bifidobacterium, which may contribute to its therapeutic effects but also cause gastrointestinal side effects.[13] Non-steroidal anti-inflammatory drugs (NSAIDs) and statins have also been shown to shift microbial composition, potentially affecting gut barrier integrity and systemic inflammation.[14] Long-term psychotropic medications, including selective serotonin reuptake inhibitors (SSRIs) and antipsychotics, can alter microbial populations, contributing to metabolic dysregulation and gastrointestinal disturbances.[15] These findings underscore that chronic pharmacotherapy is a key modulator of gut microbial ecology, necessitating careful consideration of microbiome interactions in disease management.

SOURCES OF PREBIOTICS ELDERLY POPULATION

Prebiotics—non-digestible fibers and oligosaccharides—selectively stimulate beneficial microbes including Bifidobacterium and Lactobacillus, enhancing microbial diversity, SCFA production, and gut health.[5,16] Indian diets are naturally abundant in prebiotics due to longstanding reliance on fiber-rich plant staples.

Key prebiotic sources include:

- Inulin (garlic, chicory root, onions): boosts Bifidobacteria, increases butyrate, supports immune modulation.[1,16]
- Fructooligosaccharides (FOS) (bananas, tomatoes, yacon): enhance gut motility, improve glycemic control.[5]
- Resistant starch (cooled rice, green bananas, millets, legumes): fermented to SCFAs, improves insulin sensitivity, reduces inflammation.[3,5,16]
- Beta-glucans (barley, oats): lower cholesterol, increase microbial richness, strengthen immunity.[5]

Emerging indigenous options such as jackfruit fiber, amla pectin, and millet bran are being incorporated into functional foods like low-glycemic snacks, herbal teas, and nutraceutical sachets for elderly nutrition.[6,17] Traditional rural and tribal diets high in these substrates correlate with richer gut diversity, whereas urbanized elders often show reduced intake and microbiota richness.[3,16]

Importance of Gut Microbiome

Gut microbiome help in the production of SCFA, which strengthens barrier integrity and reduces inflammation.[2,4,5] The diversity of microbes in the gut helps in the reduction of endotoxin translocation and inflammaging.[1,4,5] The acidification of the colon and competitive exclusion limits the growth of opportunistic pro-inflammatory pathogens.[2,4] SCFAs modulate host lipid and glucose metabolism, improving cardiometabolic health.[5,6] SCFAs maintain bowel regularity and stool consistency.[1,2] Reduction in systemic inflammatory markers such as IL-6 and CRP is observed. There is enhancement of immune function with increased anti-inflammatory cytokines and natural killer cell activity.[1] Also, there is emerging evidence of cognitive benefits via modulation of neuroinflammation through the microbiota-gut-brain axis.[4,5]

TRADITIONAL DIETARY PATTERNS IN INDIA

Indian diets, especially in rural and tribal communities, are rich in whole grains (millets like ragi, jowar, bajra), legumes, pulses, and fermented foods (idli, dosa, pickles, curd), offering a broad spectrum of prebiotic substrates.[3,5,16] The cooling and fermentation practices augment resistant starch and oligosaccharide content, further supporting gut microbial health. Fruits such as amla and jackfruit provide additional soluble fibers with prebiotic effects.[6,17] Ayurvedic

dietary principles emphasize fiber-rich, balanced meals congruent with individual Prakriti types, indirectly fostering a healthy microbiome.[4]

PROBIOTIC STRATEGIES FOR HEALTHY AGEING

Probiotics, live microorganisms conferring health benefits are key for restoring microbial balance in ageing populations. In India, Lactobacillus plantarum JBC5, isolated from Northeast Indian fermented foods, has shown anti-ageing and cognitive benefits in Caenorhabditis elegans models, extending lifespan by approximately 28% via antioxidative, stress-resistance, and immune-modulating pathways including p38 MAPK activation and serotonin gene upregulation.[17] Widely used strains in Indian formulations—L. acidophilus, L. rhamnosus, and B. longum improve gut flora balance, immune responses, and alleviate geriatric gastrointestinal disorders like constipation and irritable bowel syndrome. They also exhibit systemic anti-inflammatory and metabolic benefits.[16,18,19] Delivery formats include fortified curd, yogurt, kombucha, capsules, chewables, and powders. Synbiotics (probiotic plus prebiotic) improve colonization and nutrient bioavailability.[16,19] The Food Safety and Standards Authority of India (FSSAI) permits only structure-function claims such as "supports digestive health," recommending prebiotic intakes of 2–10 g/day and strain-specific probiotic dosages.[5,19]

RECOMMENDATIONS FOR GERIATRIC PRACTICE

1. **Microbiome Profiling:** Incorporate stool-based gut microbiome analyses in routine geriatric assessments to personalize microbiome-targeted interventions, utilizing data from initiatives like the Indian Human Microbiome Initiative and regional biobanks.[2,18]
2. **Diet-Based Interventions:** Promote traditional fermented foods alongside culturally relevant, fiber-rich diets to nurture beneficial microbiota.[5,6]
3. **Personalized Synbiotics:** Tailor combinations of prebiotics and probiotics according to Ayurvedic Prakriti and local dietary habits to optimize gut health.[4]
4. **Public Education:** Launch programme to improve gut health literacy among elderly populations and caregivers, addressing misconceptions and promoting scientific understanding of probiotics and prebiotics.[16]
5. **Research Investment:** Support indigenous microbiome research, including genomic characterization of native probiotic strains and establishment of comprehensive microbial biobanks.[18]
6. **Multidisciplinary Collaboration:** Engage geriatricians, microbiologists, nutritionists, and policymakers in designing and implementing microbiome-centered ageing interventions.
7. **Longitudinal Monitoring:** Initiate cohort studies to track microbiome dynamics across ageing in Indian populations to inform causal and interventional research.

CONCLUSION

The gut microbiome of the aged Indian population represents a distinctive ecological and functional entity shaped by genetic diversity, dietary traditions, environmental exposures, socio-cultural practices, and Ayurvedic constitution. Ageing correlates with reduced microbial richness, depletion of key SCFA producers (F. prausnitzii, Roseburia), and enrichment of pro-inflammatory and opportunistic taxa, contributing mechanistically to chronic diseases such as type 2 diabetes, cardiovascular disease, neurodegeneration, and sarcopenia. Despite urbanization and Westernized diets, many rural and tribal communities maintain rich microbial diversity through fiber-rich and fermented dietary practices.

Leveraging indigenous prebiotic sources—millets, jackfruit fiber, amla pectin, and resistant starch-rich staples—and employing scientifically validated probiotics like L. plantarum JBC5 and B. longum offer culturally congruent, practical approaches for microbial restoration. Personalized synbiotic interventions informed by microbiome profiling and Ayurvedic phenotyping, alongside public education and research investment, can elevate geriatric care. Microbiome targeting should be considered a central pillar in extending health span and lifespan. Thus, a national geriatric microbiome strategy—rooted in India's cultural heritage and biodiversity yet aligned with precision nutrition and microbial therapeutics—is both timely and transformative.

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Management and Challenges of Respiratory Diseases in the Elderly

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Abstract

The global rise in the elderly population has led to a surge in chronic respiratory diseases, necessitating focused geriatric respiratory care. Physiological and immunological alterations associated with ageing compromise lung function, leading to conditions like COPD, pneumonia, interstitial lung diseases, and tuberculosis. These diseases present unique diagnostic and therapeutic challenges, compounded by comorbidities, frailty, and cognitive decline. This review discusses the age-related pulmonary changes, management complexities in specific diseases, diagnostic difficulties, and the need for individualized, interdisciplinary care approaches. It also highlights ethical considerations and future directions for improving respiratory health in the ageing population.

INTRODUCTION

The number of individuals aged over 65 is expected to exceed 2 billion by 2050, accounting for nearly 20% of the global population. In India, the elderly population is expected to rise from 10.1% in 2021 to 13.1% by 2031. This demographic transition is accompanied by a rising prevalence of chronic respiratory diseases, including chronic obstructive pulmonary disease (COPD), bronchial asthma, tuberculosis (TB), and interstitial lung disease (ILD). Respiratory conditions are among the leading causes of morbidity and hospitalizations in elderly patients, creating significant healthcare challenges.

Physiological and Structural Changes in the Ageing Lung

Ageing significantly impacts the structure and function of the respiratory system. These changes include:

- **Thoracic Changes**: Age-related osteoporosis and kyphosis stiffen the rib cage, reducing thoracic compliance. This leads to increased work of breathing and diaphragmatic fatigue.
- **Airway and Alveolar Remodeling**: Enlargement of alveolar ducts and thickening of alveolar sacs, combined with a reduction in alveolar surface area, impairs gas exchange. This can lead to premature airway closure and ventilation-perfusion mismatch.
- **Respiratory Muscle Weakness**: Reduced inspiratory and expiratory muscle strength affects cough efficiency and mucus clearance.
- **Lung Volumes**: Declines in vital capacity, FEV1, and maximum oxygen uptake are observed, while residual volume and functional residual capacity increase.
- **Immunosenescence**: Ageing alveolar macrophages and epithelial cells exhibit senescence markers, oxidative stress, and reduced immune function, increasing susceptibility to infections and chronic inflammation.

DISEASE-SPECIFIC CHALLENGES AND MANAGEMENT

Chronic Obstructive Pulmonary Disease (COPD)

COPD is one of the most common respiratory conditions in the elderly, accounting for high morbidity and mortality.

- **Challenges**:
  - Underreporting of symptoms due to cognitive decline and poor perception of dyspnoea, poor mobility due to musculoskeletal issues.
  - Poor compliance with inhalers due to arthritis or coordination issues.
  - Recurrent exacerbations requiring hospitalization and intensive care treatment.

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- Polypharmacy due to multimorbidities and potential drug-drug interactions.

- **Management:**
  - Educate patients on appropriate usage of inhaler, involvement of caregivers and imparting health education through Telemedicine.
  - Vaccination against influenza and pneumococcus.
  - To implement pulmonary rehabilitation and smoking cessation programme.

PNEUMONIA

Elderly individuals are at high risk of pneumonia due to poor immunity and comorbidities.

- **Challenges**
  - Recurrent aspiration pneumonia due to dysphagia and neuromuscular disorders.
  - Misdiagnosis due to atypical symptoms and presentation.
  - Antibiotic side effects and resistance.
- **Management**
  - Early diagnosis and tailored antibiotic therapy.
  - Nutritional support and physiotherapy.
  - Vaccination and preventive care.

INTERSTITIAL LUNG DISEASE (ILD)

ILDs like IPF are more prevalent in older adults and have a progressive, debilitating course.

- **Challenges**
  - Diagnostic delays due to overlapping symptoms.
  - Limited efficacy of immunosuppressive therapies.
- **Management**
  - Use of antifibrotic agents (e.g., pirfenidone, nintedanib).
  - HRCT and serology for accurate diagnosis.
  - GERD management and palliative care support.

PULMONARY EMBOLISM (PE)

A common cause of unexpected deaths in elderly inpatients.

- **Challenges**
  - Nonspecific symptoms and diagnostic overlap.
  - Risk of contrast-induced nephropathy in imaging.
- **Management**
  - Anticoagulation with monitoring for bleeding.
  - Use of V/Q scan in patients with renal impairment.
  - Consideration of IVC filters when anticoagulation is contraindicated.

ASTHMA IN THE ELDERLY

Asthma can persist or develop *de novo* in older adults and is often underdiagnosed due to symptom overlap with COPD.

- **Challenges**
  - Difficulties in distinguishing from COPD (Asthma-COPD Overlap Syndrome).
  - Reduced perception of symptoms like dyspnea.
  - Poor inhaler technique due to cognitive or physical limitations.
  - Increased sensitivity to medication side effects (e.g., α-agonists, corticosteroids).
- **Management**
  - Personalized treatment plans with simplified regimens.
  - Use of spacer devices to assist with inhaler use.
  - Close monitoring for adverse effects.
  - Pulmonary rehabilitation and lifestyle modifications.

TUBERCULOSIS (TB)

TB in elderly populations is often reactivation of latent infection and is worsened by malnutrition and comorbidities.

- **Challenges**
  - Atypical presentations leading to delayed diagnosis associated with poor nutrition, frailty.
  - High rates of adverse drug reactions to anti-tubercular treatment.(e.g., hepatotoxicity, visual loss).
  - Drug–drug interactions with common medications like anticoagulants and anti-epileptics.
  - Social stigma, isolation, and poor treatment adherence.
- **Management**
  - Comprehensive geriatric assessment before starting therapy.
  - Directly Observed Therapy (DOT) to ensure compliance.
  - Nutritional and psychosocial support.
  - Involvement of community health workers for follow-up.

LUNG CANCER

Lung cancer is predominantly a disease of older adults, with over two-thirds of cases diagnosed in people over 65.

- **Challenges**
  - Reduced tolerance to aggressive therapies like surgery or chemotherapy.
  - Invasive diagnostics (CT-guided biopsy, bronchoscopy) may be risky.
  - Comorbidities complicate oncologic decision-making.
  - Risk of under-treatment due to age bias.
  - Not many clinical trials for newer agents in elderly.
- **Management**
  - Use of targeted therapies (e.g., KRAS, MET, BRAF mutations) when molecular profiling allows.
  - Multidisciplinary tumor boards with geriatrician on board to tailor individualized plans.
  - Palliative and supportive care to maintain quality of life.
  - Careful balance between treatment effectiveness and functional reserve.

DIAGNOSTIC AND INTERVENTIONAL CHALLENGES

Imaging Limitations:

- **Chest X-ray** may be inadequate due to difficulty in patient positioning.

- **CT and CTPA** are limited by motion artifacts, contrast nephropathy, and co morbid kidney disease.
- **Ultrasound** offers a bedside, non-invasive option for detecting effusions and consolidation.
- **Nuclear scans** are useful alternatives when contrast use is contraindicated.

Pulmonary Function Testing

- Elderly patients may not be able to complete spirometry accurately.
- **Impulse Oscillometry** and **FeNO** provide less effort-dependent alternatives.

Bronchoscopic Interventions

- Flexible bronchoscopy, EBUS-TBNA, and minimally invasive procedures are generally safe with appropriate sedation adjustments.
- Advanced interventions such as thermal ablation and stents are increasingly used in elderly patients with lung cancer.

ETHICAL AND GERIATRIC CONSIDERATIONS

- **Shared Decision-Making**: Involving patients and caregivers in discussing treatment options is essential for ethical care.
- **Advance Care Planning**: Conversations about resuscitation status, palliative care, and end-of-life preferences should be initiated early.
- **Informed Consent**: Adjustments may be needed in communication for patients with hearing loss, cognitive decline, or language barriers.
- **Frailty and Functional Status**: Therapeutic decisions must be guided not just by disease severity but by the patient's overall functional reserve and intrinsic capacity.

FUTURE DIRECTIONS AND RESEARCH

- **Telemedicine**: Remote consultations and monitoring can bridge care gaps, especially in rural areas or during pandemics.
- **Artificial Intelligence (AI)**: AI in radiology and spirometry may improve diagnostic accuracy and early detection.
- **Geriatric Pulmonary Research**: Research in lung ageing will give better insight into cellular senescence, ageing fibroblasts, and environmental pollution effects and to develop targeted treatment for chronic respiratory diseases will improve survival outcomes in the elderly
- **Integrated Care Models**: Collaborative care between pulmonologists, geriatricians, physiotherapists, and social workers can optimize outcomes.

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The Enigma of Pyrexia: Unrevealing Fever of Unknown Origin in an Immunocompetent Patient

Pritam Kundu[1], Jayanta Sharma[2], Hirak Mazumder[3], Arup kumar Sahu[4], Mohidur Rahaman[5]

Abstract

Histoplasmosis is a fungal infection caused by the dimorphic fungus Histoplasma capsulatum. In the immunocompromised individual, a disseminated form of the disease can be frequent. We provide a case of disseminated histoplasmosis in an immunocompetent person, emphasizing the significance of maintaining a high index of suspicion even in immunocompetent people, which is a rare entity. Also, its presentation as a fever of unknown origin is also rare, which was present in our case.[1-3]

Keywords:Disseminated Histoplasmosis, Fever of unknown origin, immunocompetent, granuloma.

INTRODUCTION

Histoplasmosis is caused by the dimorphic fungus Histoplasma capsulatum. Humans may be infected with H. capsulatum via inhaling microconidia and mycelial fragments of the organism. Patients with AIDS or receiving immunosuppressive agents are easy to infect with H. capsulatum. Immunocompetent patients are also occasionally infected with H. capsulatum, which is usually expressed through nonspecific clinical manifestations such as prolonged fever, weight loss, oropharyngeal ulcers, hepatosplenomegaly, and lymphadenopathy. Here we report a case of histoplasmosis exhibited as fever of unknown origin in an immunocompetent male.[2,4,5]

CASE REPORT

70 year old gentleman, who is a retired bank officer by profession from north Kolkata, presented with complaints of intermittent fever in the range of 101-103°F for the last 2 months associated with unintentional weight loss and dry cough. He had no history of associated chills, rigors, shortness of breath, haemoptysis, vomiting, loose motions, night sweats, or burning micturition.

He was a known case of type 2 diabetes mellitus with good glycaemic control (HbA1C - 6.8) and COPD. He had a history of recurrent hyponatremia for the last 2 years, but the cause was unknown. The patient was on oral medicines for diabetes and inhalers for COPD.

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On examination he was found to be hemodynamically stable with a raised body temperature (100.6°F). In the chest bilateral coarse crepitations were heard in the infra-scapular area of the posterior chest wall. Subsequent investigations revealed leukopenia (TLC – 3300/cumm), raised CRP (5.2mg/dl), iron deficiency anaemia. Blood culture was sterile. Malaria and dengue serology were negative, blood for gamma interferon TB and scrub typhus were negative. Hyponatremia was present, which was of the SIADH pattern. HRCT Thorax was done, which showed bilateral consolidation with ground glass opacities in the lower lobes of both lungs.

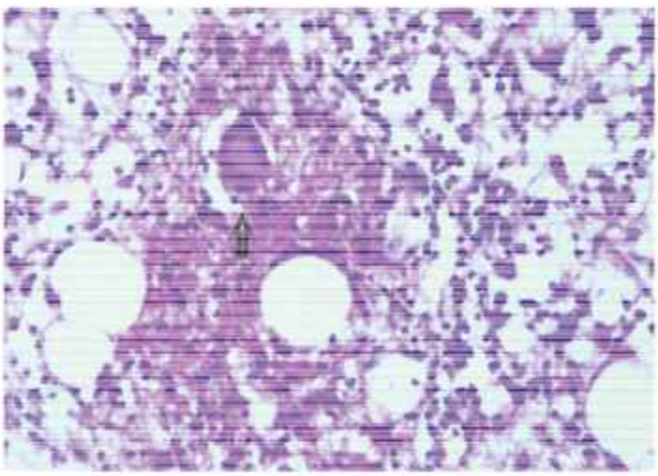
HRCT THORAX : bilateral consolidation with ground glass opacities in the lower lobes

RELEVANT INVESTIGATIONS FINDINGS

- Hb - 8.4 g/dL ⬇
- TLC - 3300/cumm ⬇
- Platelate - 1.7 L/cumm
- CRP - 5.2 mg/dL ⬆
- Procalcitonin - 0.34 ng/mL
- Lactate - 0.94 mmol/L
- Sodium - 127 mEq/L ⬇
- Potassium - 4.2 mEq/L
- RFT - Normal
- LFT - Normal
- ECHO - LVEF 55%, No RWMA
- Serum osm. - 272 msom/L ⬇
- Urine osm. - 348 msom/L ⬆
- Urine spot sodium - 54 mE/L ⬆
- Serum cortisol - Normal

The patient was commenced on IV fluids, IV antibiotics, and nebulisation for pneumonia in the background of COPD. But it did not improve the clinical condition of the patient after 5 days of antibiotic therapy. He had undergone EBUS, and bronchoalveolar lavage was negative for MTB GeneXpert, the galactomannan level was 1.81(raised), serum ACE level was normal. FDG PET CT of the whole body showed a local area of consolidation in bilateral lungs, mediastinal hilar lymph node enlargement, and unilateral rim enhancing adrenal nodules with necrosis on the left side .

In view of persisting leukopenia, bone marrow biopsy was done, which showed granuloma in bone marrow. Urinary histoplasma antigen was sent, which came back positive. The patient was screened for HIV serology and it came back negative. The absolute neutrophil count was > 1000, and the CD4 count was also normal. The patient was commenced on inj. Liposomal amphotericin B (5mg/kg/day) for 2 weeks, which improved the patient's condition. He became afebrile after 3 days of antibiotic therapy. Then Tab. Itraconazole 200 mg twice daily for 12 months was given as maintenance therapy.



Bone Marrow Biopsy : Presence of granuloma

DISCUSSION

Histoplasma capsulatum is a dimorphic fungus. It can exist as a mold in the environment at 25°C and as a yeast in tissues at 35°C to 37.8°C. H. capsulatum var. capsulatum and H. capsulatum var. duboisii are 2 varieties of H. capsulatum pathogenic to humans. The humid environment with strong winds and low sunshine levels is suitable for H. capsulatum growth.[6,7]

In our case, the patient presented with features of fever of unknown origin. Cough, haemoptysis, urinary symptoms, vomiting, diarrhoea, or other potential diagnostic clues were absent. Leukopenia was present, which is unusual in bacterial sepsis. Tropical fever screening was also negative. In bronchoalveolar lavage, raised galactomannan indicates towards a fungal infection. Bone marrow biopsy showed granuloma, which favours the histoplasma infection. And it is to be confirmed by urinary histoplasma study.

But disseminated histoplasma infection is a rare manifestation in immunocompetent individuals.[8]This patient was screened for immunodeficiency state, but it came back negative, ANC was > 1000/cumm. He had history of diabetes, but it was well controlled, HbA1C was < 6.8.

CONCLUSION

Disseminated histoplasmosis can be a differential diagnosis of fever of unknown origin. In immunocompetent individuals, it can also be manifested. Although isolation of H. capsulatum from culture is the gold standard for diagnosing disseminated histoplasmosis, bone marrow aspiration can also provide diagnostic value when the leukocyte, erythrocyte, or platelet levels simultaneously descend. Gold Standard treatment based on classical amphotericin B, but voriconazole, itraconazole, and posaconazole may be used as salvage treatment option. Early diagnosis and proper antifungal therapy can prevent its progression and cure the disease.[9-10]

DECLARATIONS

Patient consent – Patient's consent has been taken for publishing this case report.

Animal studies – Not applicable

Author contributions - Dr Pritam Kundu has written this case report and was involved with the diagnosis and treatment of the patient along with

Dr Jayanta Sharma , Dr Hirak Majumder, Dr Arup Sahu, and Dr Mohidur Rahaman.

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Focal Segmental Glomerulosclerosis as a Cause of Elderly-Onset Nephrotic Syndrome: A Case Report and Literature Review

Preetam N Wasnik[1], Pranita[2], Vyshnavi[3], Vinay Rautiya[4]

Abstract

Focal Segmental Glomerulosclerosis (FSGS) is a well-recognized cause of nephrotic syndrome in young and middle-aged adults, but its occurrence in the elderly is less frequently reported and often underdiagnosed. While more rare, primary FSGS can and does occur in elderly patients. In elderly patients, secondary causes of FSGS become increasingly prevalent, including hypertension, obesity, and prior renal insults. As a result, a diagnosis of primary FSGS requires careful exclusion of secondary forms. Renal biopsy is essential not only to confirm the presence of segmental sclerosis and to evaluate the pattern and distribution of lesions also to rule out other causes. Diagnosing and treating nephrotic syndrome in the elderly poses unique challenges due to age-related comorbidities (e.g., diabetes, cardiovascular disease), altered pharmacokinetics, and increased susceptibility to medication side effects. Immunosuppressive therapy, while potentially effective in primary FSGS, must be used cautiously in the elderly. The risks of infection, bone loss, metabolic disturbances, and cardiovascular events are heightened, making risk-benefit assessment essential.

We present the case of a 64-year-old male with new-onset nephrotic syndrome who was subsequently diagnosed with FSGS on renal biopsy. This case highlights the need for heightened clinical suspicion and the role of histopathological evaluation in elderly patients with proteinuria, even in the absence of classical features.

Keywords: *Elderly, Nephrotic syndrome, FSGS, Renal Biopsy,Challenges*

INTRODUCTION

The elderly population is growing rapidly. As of 2023, approximately 1.1 billion individuals aged 60 and older reside globally, constituting about 13.9% of the total population. By 2050, this demographic is expected to double to 2.1 billion, making up 22% of the global population. The spectrum of glomerular diseases varies with age. While membranous nephropathy remains the most frequently diagnosed lesion in elderly-onset nephrotic syndrome, other etiologies like FSGS are increasingly recognized.[1] Neoplastic processes may underlie membranous nephropathy in a significant proportion of elderly individuals, particularly those over 60, with lung and colon carcinomas being most common.[1] Tumor antigens and antibodies have been found in glomeruli of affected individuals, linking oncologic and renal pathophysiology.[2] FSGS is a podocytopathy that can manifest clinically with nephrotic syndrome along with AKI, hypertension (HTN), and progressive CKD. Renal biopsy is essential for establishing a definitive diagnosis, excluding secondary causes and guiding treatment. We describe a case of FSGS in an elderly patient initially suspected to have membranous nephropathy.

CASE DETAILS

A 64 year old male, presented with generalised body swelling, foaming in urine from 45 days associated with progressive fatigue, history of Hypothyroidism from 6 months on 50 micrograms daily of levothyroxine and no history of diabetes, NSAID use, or recent infections.

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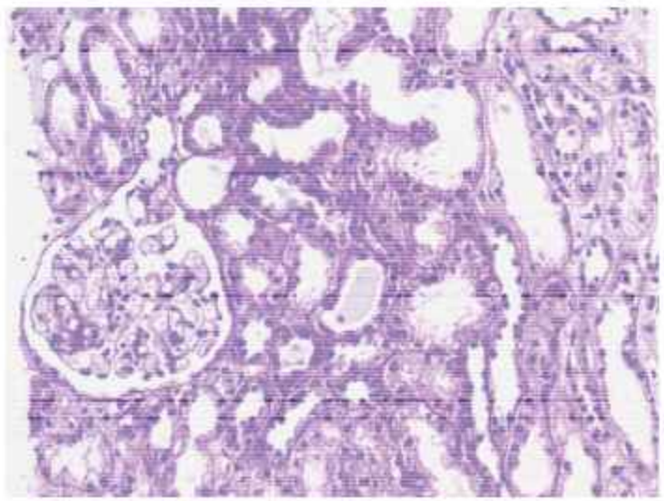

Figure 1

On examination

Pulse rate 88 bpm, normal volume, regular; BP 130/90 mmHg. There was no pallor and icterus but anasarca was present with periorbital puffiness.

On Investigations

Serum Albumin: 1.8 g/dl, Serum Creatinine: 1.3 mg/dl, Urine Routine microscopy : 3+ protein, no casts and crystals, 3 RBC/hpf, Urine for Dysmorphic RBC : Negative, 24 hour urinary protein : 6 grams/24 hours; HIV, Hepatitis B, Hepatitis C serology: Non Reactive, HPLC: Normal Hemoglobin pattern, ANA, ANCA, SPEP : Normal , Complement levels : Normal, USG Kidneys: Normal sized kidneys with preserved corticomedullary differentiation

Given the absence of systemic disease or secondary causes, a percutaneous renal biopsy was performed.

Histopathology : (Figure 1) was suggestive of Focal and Segmental sclerosis (FSGS).

DISCUSSION

Primary FSGS may cause nephrotic syndrome in elderly although membranous nephropathy is most common and can lead to ESRD in approximately 40% of patients due to its complex aetiology and often poor response to steroid therapy. FSGS can be primary or secondary to factors like mutations, infections, or drugs. Patients with nephrotic-range proteinuria have worse outcomes compared to those with sub-nephrotic presentations. Elevated serum creatinine and the degree of interstitial fibrosis at diagnosis are strong prognostic indicators.[4,5] This case illustrates the diagnostic value of biopsy and supports including FSGS in the differential diagnosis for elderly patients with nephrotic syndrome.[6-8]

CONCLUSION

FSGS, though uncommon, should be considered in the differential diagnosis of nephrotic syndrome in the elderly. Renal biopsy remains the gold standard for diagnosis and guides immunosuppressive therapy. Early detection and management can significantly alter the clinical trajectory and preserve renal function.

Renal cortical parenchyma with 20 glomeruli, 10% were globally sclerosed,One glomerulus reveals tuft sclerosis. Significant proliferative or exudative activity was not observed, No evidence of crescent formation or tuft necrosis, sub endothelial deposits, intra capillary thrombi. Tubular atrophy and interstitial fibrosis involved less than 10% of the sample DIF studies did not show any glomerular immune staining, suggestive of Focal and Segmental sclerosis (FSGS).

Undertaking: The case report is not under consideration elsewhere and have not been reported earlier partly/totally.

Acknowledgement : All authors have made significant contributions to the study and have read and approved the contents.

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From Joints to Meninges: An Unusual Neurological Complication of Chikungunya Fever

Pradnya Mukund Diggikar,[1] Janani R,[2] Akhilesh Jagirdar,[3] Kishor Khillare[4]

Abstract

Background: *Chikungunya virus (CHIKV) infection is an arboviral illness transmitted by Aedes aegypti and Aedes albopictus mosquitoes, primarily presenting as an acute febrile illness with polyarthralgia. However, atypical and severe manifestations, particularly neurological and hepatic involvement, are increasingly recognised in vulnerable populations such as neonates, immunocompromised individuals, and the elderly.*

Case Summary: *We report a rare case of an elderly patient with no known comorbidities who presented with acute onset of high-grade fever, progressive lower limb weakness, and altered mental status. Clinical evaluation revealed features consistent with meningeal irritation, while investigations showed leukopenia, thrombocytopenia, elevated liver enzymes, and positive serology for Chikungunya. Cerebrospinal fluid (CSF) analysis suggested viral meningitis. Hepatitis serologies were negative, and the hepatic dysfunction was attributed to CHIKV. The patient was managed supportively in an intensive care setting with IV fluids, antipyretics, empirical antibiotics, antiviral coverage, and close monitoring of liver function and platelet counts.*

Outcome: *After a challenging course with persistent fever and sensorium disturbances, the patient showed gradual neurological and hepatic recovery. Full orientation and clinical stability were achieved by day 13 of admission.*

Conclusion: *This case underscores the importance of recognising Chikungunya virus as a potential cause of severe systemic complications such as meningitis and hepatitis, especially in elderly individuals—even in the absence of predisposing comorbidities. Early identification and prompt supportive care are key to improving outcomes in such rare presentations.*

Keywords- *Chikungunya virus, Viral meningitis, Chikungunya-associated hepatitis, Atypical arboviral infection, Elderly neurological complications*

INTRODUCTION

Chikungunya fever is a re-emerging tropical disease caused by the Chikungunya virus (CHIKV), an RNA virus belonging to the Alphavirus genus of the Togaviridae family.[1] Since its reappearance in the Indian subcontinent and parts of Africa and Southeast Asia, Chikungunya has been associated with outbreaks marked by high morbidity but low mortality. The classical clinical picture involves an abrupt onset of fever, joint pain, myalgia, rash, and headache. Most cases are self-limiting and resolve within 7–10 days.[2,3]

However, recent literature has highlighted that atypical manifestations—including neurological, cardiovascular, renal, and hepatic involvement—may occur, particularly in high-risk groups such as neonates, immunocompromised patients, and the elderly.[4] Neurological complications reported range from encephalitis and Guillain–Barré syndrome to transverse myelitis and meningitis. Simultaneous hepatic involvement, though less frequently described, may manifest as transaminitis or acute hepatitis.

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Meningitis caused by CHIKV is an under-recognized entity, and its pathophysiology is still not completely understood. The virus is postulated to cross the blood–brain barrier either via infected leukocytes or through direct endothelial disruption. Similarly, hepatic dysfunction in Chikungunya may result from viral-induced hepatocellular damage, immune-mediated injury, or hypoxic hepatitis in severe systemic illness.[5]

This case report presents a unique and rare occurrence of Chikungunya-associated meningitis with concurrent hepatitis in an elderly patient who had no prior comorbidities. The case exemplifies the diagnostic challenges and emphasizes the need for awareness regarding such severe atypical presentations, especially during outbreaks or in endemic regions.

CASE PRESENTATION

A 72-year-old male, previously healthy with no known comorbidities, presented to the emergency department with a two-day history of high-grade fever associated with chills and generalized bodyache. He subsequently developed progressive weakness in both lower limbs, followed by altered sensorium and reduced responsiveness. There was no history of seizures, vomiting, or trauma, and no recent travel or exposure to known toxins. He was not on any long-term medications, and there was no personal or family history of diabetes, hypertension, chronic liver disease, or neurological illness.

On initial examination, the patient was febrile (104°F), heart rate: 109 bpm, with a blood pressure of 100/70 mmHg and oxygen saturation of 97% on room air. He appeared drowsy, was not oriented to time or place, and responded minimally to verbal stimuli.

Neurological examination revealed: Hypotonia in all four limbs, decreased deep tendon reflexes, positive signs of meningeal irritation, No focal neurological deficit or cranial nerve involvement, Plantar reflexes were bilaterally flexor.

There was neck rigidity, Kernigs positive, Brudzinski positive, but the patient's cooperation was suboptimal due to altered mentation. Examination of other systems, including cardiovascular, respiratory, and gastrointestinal systems, was unremarkable.

Laboratory investigations on admission showed:

- Leukopenia with a total leukocyte count of 4,300/mm³
- Progressive thrombocytopenia, with platelets decreasing from 87,000/mm³ to 60,000/mm³ over 48 hours
- Liver function tests revealed significantly elevated transaminases (SGOT > 450 IU/L, SGPT > 400 IU/L) and total bilirubin of 2.8 mg/dL
- Renal function and electrolytes were within normal limits

MRI Brain plain and contrast was normal.

Peripheral blood smear was negative for malarial parasites, and dengue NS1 antigen and IgM were also negative. Blood cultures and urine cultures showed no growth. Serology for Chikungunya IgM was negative, ruling out acute CHIKV infection. Hepatitis serology (HAV, HBV, HCV, HEV) returned negative, ruling out common viral causes of hepatitis.

A lumbar puncture was performed after platelet counts stabilised. CSF analysis showed:

- Clear appearance
- Mild lymphocytic pleocytosis
- Elevated protein
- Normal glucose

These findings were consistent with viral meningitis. CSF Cultures, Malignant cytology and NIV panel was sent.

The patient was admitted to the intensive care unit (ICU) for close monitoring. Initial treatment included:

- Empirical intravenous antibiotics (Ceftriaxone) 2 gm IV, twice daily
- Antiviral therapy with acyclovir
- Intravenous fluids and antipyretics

Despite persistent high-grade fever and altered mental status during the initial days of hospitalization, the patient remained hemodynamically stable. Daily monitoring of hepatic enzymes and platelet count was conducted.

Patient persisted to have high grade fever of 104 degree Fahrenheit, Liver function test showed increasing trend, in view of which Doxycycline was initiated.

Serology for Leptospirosis was sent, which tested negative.

On Day 4: Patient persisted to have high grade fever with blanching rash all over body and developed bilateral lower limb swelling extending upto knee associated with calf tenderness and warmth, DVT screening was done, which reported as Bilateral lower limb cellulitis.

Daily dressing and both limb care and elevation was done along with position change and bowel, bladder, body care.

Patient persisted to have high grade temperature, 4-5 spikes per day with chills and rigour, not responding to antibiotics. Platelets count decreased to 27,000/mm³.

CSF cultures tested negative, Malignant Cytology reported negative, Blood smear for Malarial parasite was negative

By day10, platelet counts began to rise, and hepatic enzymes showed a downward trend.

By day14, the patient began responding to verbal commands and was gradually oriented to time, place, and person.

By day16, the patient's condition had improved significantly. He was afebrile, alert, able to follow commands, and mobilizing with assistance. He was shifted to the general ward for further observation and was discharged in a stable condition on day 20, with advice for outpatient follow-up and serial liver function monitoring.

On Day 25, after discharge, Patients NIV panel had tested positive for Chikungunya virus Ig M positive .

DISCUSSION

Chikungunya virus (CHIKV) infection has gained increased attention due to its resurgence in endemic areas and its potential for causing severe complications beyond its typical presentation. Although it is commonly associated with an acute febrile illness

accompanied by arthralgia, a growing body of literature has documented its capacity to induce neurological and hepatic complications, especially in high-risk groups such as neonates, pregnant women, immunocompromised individuals, and the elderly.[1,4,5]

In this case, the patient, a 72-year-old male with no known pre-existing comorbidities, presented with acute viral meningitis and hepatitis, confirmed to be secondary to Chikungunya infection. This dual complication is a rare but clinically significant presentation, and its early identification can be challenging in regions where multiple arboviral infections (like dengue and Zika) co-circulate and share overlapping clinical features.

Neurological manifestations of CHIKV range from encephalopathy, encephalitis, meningitis, myelitis, to Guillain-Barré syndrome. The exact mechanism of neuroinvasion is not fully elucidated but may involve direct viral entry into the CNS or immune-mediated mechanisms triggered by the infection. In this patient, cerebrospinal fluid (CSF) findings of lymphocytic pleocytosis, elevated proteins, and the absence of bacterial pathogens supported the diagnosis of viral meningitis. Furthermore, the absence of other etiological agents (negative bacterial cultures, negative dengue and malaria testing) helped strengthen the diagnosis of Chikungunya-associated meningitis.

Hepatic involvement in CHIKV is also underreported and can range from mild transaminitis to acute hepatitis with jaundice. In our patient, the transaminase levels were significantly elevated, with raised bilirubin, but there was no clinical evidence of liver failure. Importantly, viral hepatitis panels (HAV, HBV, HCV, HEV) were negative, suggesting that the hepatic dysfunction was a direct complication of Chikungunya. This hepatic involvement may be due to direct cytopathic effects of the virus on hepatocytes or indirect immune-mediated injury.

This case emphasizes two important considerations. First, age alone is a significant risk factor for severe and atypical disease in CHIKV infections, even in the absence of traditional comorbidities such as diabetes or cardiovascular disease. Second, atypical presentations such as central nervous system involvement and hepatitis should be actively considered and investigated in febrile patients with neurological symptoms in endemic areas, especially when routine investigations are inconclusive.

Timely supportive care remains the cornerstone of management in such cases, as no specific antiviral therapy exists for CHIKV. In this case, the use of empirical antivirals (acyclovir), antibiotics (ceftriaxone, doxycycline), liver supportive care, and intensive monitoring led to a complete clinical recovery, highlighting the importance of a multi-disciplinary approach in managing complex viral infections.[4,5]

CONCLUSION

This case report documents a rare and severe presentation of Chikungunya infection in an elderly patient without comorbidities, manifesting as viral meningitis and concurrent hepatitis. It highlights the importance of considering Chikungunya virus as a differential diagnosis in patients with unexplained fever and neurological or hepatic dysfunction, particularly in endemic regions or during outbreak settings.

The case also underscores the need for increased clinical vigilance, especially in elderly populations, who may be at greater risk of developing atypical and severe manifestations of common viral infections. Early identification, exclusion of other potential causes, and timely supportive management are essential to ensure favourable outcomes in such patients.

In the broader public health context, this case contributes to the growing understanding of Chikungunya virus's neurotropic and hepatotropic potential, calling for further research into its pathophysiology and the development of targeted treatments or preventive strategies.

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