"Assessment of nutritional status and its impact on outcome in elderly admitted with respiratory diseases in critical care unit"

BY

Dr. Sandeep Kumar

Dissertation submitted to BLDE (Deemed to be University), Vijayapura

In partial fulfilment of the requirements for the award of the degree of

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IN

GERIATRICS

Under the Guidance of

DR. ANAND P. AMBALI, M.D.

PROFESSOR & HEAD

DEPARTMENT OF GERIATRICS

BLDE (DEEMED TO BE UNIVERSITY)

SHRI B. M. PATILMEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE

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B.L.D.E (DEEMED TO BE UNIVERSITY)

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I hereby declare that this dissertation/thesis entitled "Assessment of nutritional status and its impact on outcome in elderly admitted with respiratory diseases in critical care unit" is a bona fide and genuine research work carried out by me under the guidance of -

Dr. ANAND P. AMBALI, M.D., Professor & Head, Department of Geriatrics, Shri B. M .Patil Medical College, and hospital, Vijayapura.

Date: 15-07-2024 **Dr. SANDEEP KUMAR**

Place: Vijayapura **21BMGRE01**

B.L.D.E (DEEMED TO BE UNIVERSITY)

SHRI.B.M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA.

CIRTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled "Assessment of nutritional status and its impact on outcome in elderly admitted with respiratory diseases in critical care unit" is a bona fide research work done by Dr. SANDEEP KUMAR towards the partial fulfilment of the requirement for the degree of M.D in Geriatric Medicine.

Date: 15-07-2024

Place: Vijayapura

Dr. ANAND P. AMBALI
Professor & Head
Department of Geriatrics
BLDE-DU's Shri B.M. Patil Medical College & Hospital

B.L.D.E (DEEMED TO BE UNIVERSITY)

SHRI.B.M. PATIL MEDICAL COLLEGE, HOSPITAL

& RESEARCH CENTRE, VIJAYAPURA.

ENDORSEMENT BY THE HoD, PRINCIPAL /HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled "Assessment of nutritional status and its impact on outcome in elderly admitted with respiratory diseases in critical care unit" is a bona fide research work done by Dr. Sandeep Kumar under the guidance of Dr. Anand P. Ambali, M.D., Professor & Head-Department of Geriatrics, Shri B.M Patil Medical College, hospital and research centre, Vijayapura.

Seal & Signature of HoD of Geriatrics

Dr. Anand P. Ambali

M.D. Medicine

BLDEU's Shri B.M. Patil

Medical College, Hospital &

Research Centre, Vijayapura

Dated 15.07.2024

Vijayapura

Seal & Signature of the Principal

Dr. Aravind Patil

M. S. General Surgery

BLDEU's Shri B.M. Patil

Medical College, Hospital &

Research Centre, Vijayapura

Dated 15.07.2024

Vijayapura

B.L.D.E (DEEMED TO BE UNIVERSITY)

SHRI.B.M. PATIL MEDICAL COLLEGE, HOSPITAL &

RESEARCH CENTRE, VIJAYAPURA.

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Dated-15.07.2024 **Dr. Sandeep Kumar**

Vijayapura **21BMGRE01**

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"And those who were seen dancing were thought to be insane by those who could not hear the music".

-Friedrich Nietzsche (1844-1900)

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Abbreviations

AAIM (AND) Academy of Nutrition Dietetics

ADA - American Dietetic Association

ADL- Activities of daily living

AIDS- Acquired Immune Deficiency Syndrome

AMDT - American Malnutrition Diagnostic Tool

ANOVA - Analysis of Variance

ARDS - Acute Respiratory Distress Syndrome

ASPEN - American Society of Parenteral and Enteral Nutrition

BAPEN - British Association of Parenteral and Enteral Nutrition

BIA - Bioelectric Impedance Analysis

BMI- Body Mass Index

CCU- Cardiac Care Unit

cGCP- Current good clinical practices

CKD- Chronic kidney disease

CM- Centimetres

CRP- C-Reactive Protein

CT- Computed tomography

DAMA- Discharge against medical advice

DEXA- Dual-energy X-ray absorptiometry

DFU Discharged with follow-up

ESPEN - European Society for Clinical Nutrition and Metabolism

GIT- Gastrointestinal tract

GLIM- Global leadership initiative on malnutrition

HCUP- Healthcare Cost and Utilization Project

HIV- Human Immunodeficiency Virus

HOD- Head of Department

Abbreviations- Cont'd….

IADL- Instrumental activities of daily living

IBW- Ideal Body Weight

ICD- International Classification of Diseases

ICU- Intensive Care Unit

LBM Lean Body Mass

MAC Mid arm circumference

MCV Mean corpuscular volume

MNA®- Mini Nutritional Assessment, registered with Nestlé nutrition institute

MNA-SF® Mini Nutritional Assessment- short form registered with Nestlé

MRI- Magnetic Resonance Imaging

MST- Malnutrition Screening Tool

MUAC- Mid-Upper Arm Circumference

MUST- Malnutrition Universal Screening Tool

NPO- Nil per Oral

NRS-2002- Nutrition Risk Screening 2002

PG-SGA- Patient Generated Subjective Global Assessment

PN- Parenteral Nutrition

QOL- Quality of Life

RCT- Randomised Controlled Trial

SD- Standard Deviation

SGA- Subjective Global Assessment

SNAQ- Short Nutritional Assessment Questionnaire

TB- Tuberculosis

TSF- Triceps Skinfold

TLC - Total leukocytes count

WHO- World Health Organization

List of tables

List of Figures

List of contents

Abstract

Need for the study

As the ageing population is growing world-wide, so is the risk of malnutrition in elderly population[1]. There is a high prevalence of malnutrition in elderly population, and the prevalence increases manifold in hospitalized elderly patients[2]. The reason for high prevalence of malnutrition are many and includes-multi-morbidity, atypical disease presentation, delay in seeking medical consultation due to various psycho-socio-economic factors and also includes the fear of hospital admission in elderly age group.

Disease and illness in itself is a risk factor of malnutrition and eating fewer than two meals a day adds to this problem. The frail elderly adult may be requiring assistance for self-care and for his activities of daily living. He may be suffering from tooth loss or mouth pain, chewing difficulty, economic hardships to buy food stuff, reduced social contact or may be facing involuntary weigh loss.

Patients with COPD are mostly severely undernourished for proteins. The main mechanism is hyper-metabolism, which is responsible for increased oxygen consumption by the malnourished respiratory muscles. One of the most important cause of the atrophy and decreased strength of respiratory muscles decreased exercise performance, decreased quality of life and increased risk of hospital acquired or community-acquired Pneumonia is malnutrition[3].

Mini Nutritional Assessment-short form (MNA-SF®) is an easy and reliable screening tool for physician, dietician, medical students or nurses to quickly evaluate the nutritional status of elderly adults. A low MNA-SF® score (0-7) represents malnutrition; a high score (12-14) represents normal nutrition status and an intermediate score (8-11) represents risk of malnutrition. MNA-SF® is an ideal tool for the evaluation of older adults with high specificity, sensitivity, negative and positive predictive values and a high validity.

Materials and method

The present study is a hospital-based cross-sectional study conducted on 100 elderly patients admitted with various respiratory diseases in the critical care unit (ICU) of Shri B M Patil Medical College and Research Centre, Vijayapura, after obtaining due approval from the institutional ethical committee.

Results

The study population of this study consists of 53% males and 47% females with mean age of 69.11± 7.82 years. Majority (74%) of patients fall in the age group of 60-74 years (young-old) and 65% were on mixed diet with 52% elderly patients reported a normal dietary intake.

In our study, 17% of patients were screened by MNA-SF® to be malnourished, 40% were found to be to risk of malnutrition, and 43% were normally nourished. 58% of the patients stayed below ten days in the hospital, and only 18% stayed for more than 20 days. 32% of the study population required mechanical ventilation, 28% were on non-invasive ventilation, and 26% elderly patients were given Oxygen via mask.

Considering the haematological and biochemical parameters, 72% elderly had haemoglobin less than 13 g/dL, total leukocytes counts were more than 11,000 per cu mm in 38%, mean corpuscular volume was less than 80 fL in 30% and more than 100 fL 13%. Serum Creatinine was more than 1.3 mg/dL in 34% of patients. In our study, mortality was seen in 10% of patients and 71% patients were discharged with follow-up advice. 8% of patients who died had breathlessness as the presenting complaint, 7% had three co-morbidities, 4% died due to lower respiratory tract infection as their diagnosis and 6% of them had mid-arm circumference less than 22.5 cm which was statistically significant. 6% elderly patients died due to malnutrition based on MNA-SF® finding, which is a statistically significant finding of this study.

Conclusion

Malnourished patients face heightened risks of mortality and morbidity, which can exacerbate existing conditions like chronic lung disease, sepsis, trauma, and cardiovascular dysfunction. Addressing malnutrition through systematic nutritional screening is crucial as it allows healthcare providers to identify patients at risk early on. This approach not only highlights the problem but also integrates nutritional correction as a fundamental part of patient therapy. Importantly, many of the adverse effects of malnutrition can be partially reversed with appropriate re-feeding strategies. More research is needed in this domain in the future and time will see that ―clinical nutrition‖ will be considered as ―fundamental human right‖ in the future, by the governments.

Introduction

Ageing has been most comprehensively defined as the process that converts fit adults into frailer elderly with progressive risk of illness, injury, and death. Ageing of individuals and societies is a natural, physiological and global phenomenon. Improved survival during childhood and constant improvements in life expectancy has altered the age distribution in population during the past decades. This trend towards ageing is likely to continue well into the 21st century[3]. On one hand, population ageing is a cause for celebrations, representing a triumph of medical, social and economic advancements over disease and death, while on the other hand, booming elderly population presents tremendous challenges for the functioning of the most institutions of the society including the practice of Medicine.

Older hospitalized patients are more medically complex than younger ones with large number of co-morbidities and risk of poly-pharmacy. The elderly patients are likely to have health conditions or social circumstances which complicate their management including functional decline, cognitive impairment and dwindling social support. The hospital care of elderly from admission-to-discharge include, not only an approach to the management of the ―admission problem‖ but also, an approach that recognizes common complications and attend to the special needs of this often vulnerable population[4].

In recent times, economic success manifest as plentiful nutrition unknown to past generations, this resulted in pandemic of obesity and its serious health consequences. On the other hand there is drought, famine and under-nutrition prevailing in many parts of the developing world. Quantity and quality, of food has much impact on health, and governments always advice on healthy diets and intake of fruit and vegetable. High cholesterol diets have been linked with cardio-vascular diseases, chronic diseases and cancer. Deficiencies of vitamins or minerals result in preventable conditions such as anaemia due to iron deficiency or night blindness due to vitamin A deficiency. Nutrition is essential in dealing with

the needs of individual patients and helps to formulate a dietary planning of public policy on health and nutrition by various governments.

Nutrients are classified as ―macronutrients‖ and are eaten in relatively large amounts to provide fuel for metabolic activities, and ―micronutrients‖ which includes vitamins and minerals and do not provide energy, are required in small amounts as they are not synthesised in the human body. The hypothalamus regulates energy and receives afferent signals for nutritional status in the short term from the stomach hormone ghrelin, whose levels falls immediately after consumption of food and rises gradually in the postprandial period, to suppress satiety and to indicate that it is time for the next meal. The hypothalamus also receives long term signals from leptin, which is secreted by the adipose tissue. Many local neurotransmitters affect the functioning of hypothalamus that influence hormones acting on the pituitary gland, and stabilize neural control circuits that regulate cerebral cortex and influence autonomic nervous system functioning5.

Hospital associated malnutrition and its importance were first identified by Charles Butterworth in 1974, underlining the importance of malnutrition which is usually ignored, underdiagnosed, overlooked, and as a result is undertreated in day-to-day medical practice[5]. Hospital associated malnutrition results in poor quality of life, increased cost of health care, longer length of hospital stay, mortality, and higher number of complications as compared to well-nourished patients. Elderly hospitalised patients are at risk of malnutrition, due to poverty and poor hygiene that increase the burden of diseases and complications. The aim of the present study is to evaluate the prevalence of malnutrition and its associated complications in elderly patients with respiratory diseases admitted in critical care unit of our hospital.

Research data from National health and nutrition examination survey (NHANES-III) highlights the decreased intake of Protein, Calcium, Vitamin E, Zinc and other essential nutrients in elderly population[6]. Longitudinal studies have shown that calorie intake and macro-nutrients like Proteins, Carbohydrates and fat intake

decreases with age, suggesting older adults may be at higher risk of malnutrition than younger adults.

The causes of malnutrition (under nutrition) are multiple and relate to the problems with elderly patient‘s appetite, or ability to prepare or obtain food. Poor appetite in elderly can result from many chronic conditions or due to effects of medications which are used to treat them. Also, poor functional status, cognitive impairment, or social and financial issues can limit an older patient‘s nutritional intake. Of course, some patients have conditions that impair their ability to chew or swallow as well, such as Stroke related deficits or poor fitting dentures.

Malnutrition compromises immune function making elderly patient more prone to Dysphagia and aspiration Pneumonia, Pneumonia, Tuberculosis, and exacerbation of Chronic Obstructive Respiratory Disease (COPD) or Asthma[7]. These conditions can further compromise respiratory function and leads to respiratory failure. Under-nutrition can impair body‘s ability to heal wounds, including those of respiratory tract caused by procedures such as intubation and tracheostomy. Delayed wound healing can prolong the recovery process for patient with respiratory disorders and results in complications like respiratory failure, acute respiratory distress syndrome (ARDS), and Ventilator associated Pneumonia (VAP)[7].

Respiratory failure due to pulmonary disorders often necessitates mechanical ventilation and it is the most common reason for admission to hospital‘s critical care unit (ICU). Age related chest wall, Parenchymal and vascular changes reduce the ability to compensate for the increased respiratory demands common in critical illness. Chest wall efficiency is reduced in advanced age by narrowed inter-costal space due to Osteoporosis and Kyphosis, rib cage calcification, and Sarcopenic-changes to inter-costal muscles and the diaphragm[8]. Alveolar surface area declines and the composition of pulmonary surfactant changes, decreasing the Parenchymal elasticity and forced expiratory volume in one second (FEV_1). The Parenchymal changes also result in premature closure of small airways at higher lung volumes, predominantly in lower lung fields, where blood flow is greatest, causing

mismatched Ventilation and Perfusion (V/Q mismatch). V/Q mismatching together with reduced Alveolar surface results in diminished Oxygen up-take[8].

Sarcopenia increases with advancing age. Sarcopenic skeletal muscles are characterized by an overall diminished number of muscle fibres, including increased intra-muscular lipid concentration and re-modelling of the motor units leading to reduced muscle power and strength, easy fatigability and slow gait speed[9]. Critical illness, particularly in the setting of multiple organ failure, alters atrophy-hypertrophy signalling pathways and results in additional muscle breakdown. Ubiquitous and prolonged immobility during critical illness contributes to muscle loss, decline in aerobic capacity and reduced strength. In combination, these factors results in additional catabolic insults to the ageing muscles and may in part, explains the greater incidence of critical unit acquired weakness and hospital re-admissions among older adults[10].

Nutritional deficiencies can compromise the body‘s ability to respond to therapy and delays recover from acute exacerbation of respiratory conditions. Under-nutrition causes a lasting impact on the overall health and quality of life of older patients with respiratory disorders. Weakness, fatigue and respiratory symptoms can limit physical activity, social interaction and independence, leading to increased psychological distress and consequently poor quality of life (QOL) of older adult[11].

A dietary history provides necessary information when obtained directly from the patient himself including caregiver‘s narration. Several screening tools have been developed including the nutritional screening initiative (NSI), Subjective global assessment (SGA), Malnutrition universal screening tool (MUST), Simplified nutritional appetite questionnaire (SNAQ), Geriatric nutrition risk index (GNRI), Nutritional risk screening 2002 (NRS-2002), Mini nutritional assessment (MNA), and Mini nutritional assessment- short form (MNA-SF®). MNA-SF® has been shown to be predictive for in-hospital mortality, the length of hospital stay, and a low MNA-SF® score is predictive for greater likelihood of further admission to long term health care facility[12].

Most of the studies on the nutritional assessment and outcome in the critical care unit (ICU) primarily focus on general adult population, with limited attention given to elderly patients. Given the unique nutritional needs and challenges faced by elderly individuals, there is a need for more research specifically targeting this demography within the ICU setting[13]. Moreover, there is a need for research to validate and refine the screening tools targeted for elderly Indian population admitted to ICU. Research in this domain is needed to understand the trajectory of nutritional status and its consequences on long term outcomes in older adult[13, 14].

Research on the assessment of nutritional status in geriatric patients admitted to the critical care unit (ICU) is crucial and important for several reasons. Understanding the nutritional status of elderly patient admitted in ICU can help healthcare providers tailor interventions to improve outcome[14].

Effective management of elderly patient in ICU requires a comprehensive understanding of the nutritional needs. Research in this area can help identify older patients at risk of malnutrition early in their hospitalization and guide the development of personalized nutrition plans to optimize their treatment and recovery. Under-nutrition in elderly patient in ICU is associated with increased health care resource utilization, including longer hospital stay, higher rates of readmission, and greater healthcare costs. By addressing nutritional needs proactively, research in this field has the potential to reduce the burden on healthcare systems and improve cost effectiveness.

Early identification of malnutrition can have profound impact on the quality of life of elderly patients, affecting their physical function, mental wellbeing, and overall satisfaction with care. Research in nutritional assessment in the ICU can help identify strategies to enhance the nutritional status, thereby improving the quality of life during and after hospitalization[15].

Pulmonary rehabilitation is ―a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education and behaviour changes, designed to

improve the physical and psychological condition of elderly with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviour.‖ Decreased endurance, and exercise intolerance, physical inactivity is itself associated with an earlier onset of lactic acidosis at low work rates in COPD patients, can result in a greater ventilatory demand and dyspnoea. Moreover, as physical inactivity progresses, there is increased physical disability, social isolation, anxiety, and depression, as well as risk of COPD exacerbation (hospitalization), obesity, diabetes, cardiovascular disease, and death. All these elderly patient‘s problems and rehabilitation can be addressed by early evaluation of nutritional status[16].

Adequate nutrition is a fundamental aspect of patient care, and addressing the nutritional needs of elderly patient in ICU is essential from an ethical stand point. Research in this area can contribute to the development of evidence-based guidelines and policies aimed at ensuring equitable access to nutrition support for all patients, regardless of age or health status. Overall, research in this domain is vital for optimizing clinical outcomes, enhancing quality of care, and promoting the well-being of this vulnerable yet precious part of our population and society

Aim of the study

To assess the nutritional status and to evaluate its impact on outcome of the elderly patients admitted with respiratory diseases in critical care unit.

Review of literature

Factors affecting health and well-being in elderly

Nutrition is an important area of vulnerability for older people. Weight loss is a defining feature of frailty. On the other hand, obesity is an increasing problem which sometimes persists in old age, where it is associated with Sarcopenia. Sarcopenia is an important determinant of both functional capacity and metabolic reserve in acute illness[1].

Many factors influence health, including aspects of the biological, physical and social environment, including the global ecosystem. When assessing an elderly patient, health care provider considers many levels at which problem can occur, including the body systems, organ, tissue, cellular and molecular[2].

Environmental factors affecting health and nutrition in old age focus not only on quality of life but also on life course, susceptibility to risks, and reliance of the older adults on support available. If the major goal of public health policy in the young adult is to prolong the life span, in old age, it is the quality of life which is more important that its duration[4].

The environmental factors that determine the life expectancy operates throughout the life span and usually begin much before birth. Decline in many physiological functions in old age increases risk from extreme of temperature, poverty, pollution and accidents in the home. Older people rely on the support from family, friends, government and society[6]. In present times, community, family health and financial support to older people is declining, resulting in increasing risk of neglect, poverty, under nutrition, marginalization and social isolation in this subset of the population.

The Importance of appropriate nutrition in old age

Appropriate nutrition is essential for healing and health. The amount of nutrients required by an individual differs depending upon the age and physiological state. In recent times, economic success resulted in plentiful of nutrition which was not known to previous generations, and caused a pandemic of obesity[7]. At the same time, in many parts of the developing world, under-nutrition still represents a major problem. Quality, as well as quantity of food influences health. Poor nutritional intake in an elderly person may result from loose or painful teeth, dry mouth, lost or ill-fitting denture, nausea, anorexia,

cognitive problems, dyspepsia or due to constipation[8]. Together with consequences of age related declining physiological reserves, malnutrition has far reaching deleterious effect on the health and wellbeing of an elderly person and early screening and correction is imperative in this age group[8]. Thus, a proper understanding of the factors responsible for malnutrition is therefore essential in dealing with the needs of individual patient in this age group.

The lack of essential nutrients leads to growth impairment, biochemical derangement, organ dysfunction, and failure to maintain Nitrogen balance. For the maintenance of optimal health, an individual needs energy providing nutrients e.g. carbohydrates, proteins, vitamins, fats, minerals and water[9]. Essential amino-acids, glucose, four-fat soluble vitamins, several fatty acids, ten-water soluble vitamins, dietary fibre and choline form the micronutrients part of the diet. Care must be taken for those individuals who are unable to synthesize essential nutrients due to pathologies or genetic abnormalities.

Quantitative estimates of nutrient intake measurement

Human life and well-being can be maintained with in fairly wide range with most nutrient intake. But, the capacity for adaptation is finite in older adults- too little or too much of nutrient intake will have adverse effects or can alters the health benefits obtained by the intake of nutrients[3, 10].

Malnutrition is classified as over nutrition (obesity) and under nutrition (frailty) and for the purpose of this research work, broadly, malnutrition refers to under-nutrition. Benchmark recommendations have been developed to guide the nutrients intake. Dietary reference intake (DRI) includes an estimated average requirement (EAR) for dietary planning. The other parameters include- Recommended dietary allowance (RDA), adequate intake (AI), the chronic disease risk reduction intake (CDRR), and tolerable upper level (UL). The dietary reference intake (DRI) also includes acceptable macro-nutrients distribution range (AMDRs) for proteins, fats and carbohydrates[3, 11].

Energy balance

The _macronutrient‘ content of the food determines the energy intake in an individual and it is controlled and coordinated by the hypothalamus in central nervous system. For weight to remain stable, energy output must match energy intake. The major energy depletion is due to resting energy expenditure (REE) and physical activity and is

calculated based upon physical activity, gender, age, weight, and height. Dietary protein consists of both essential and non-essential amino acids that are required for protein synthesis. Alanine and nine other essential amino acids can be used for gluconeogenesis, protein synthesis, and for energy generation[12]. Protein intake must be increased in conditions where energy intake is low or in-adequate, so that amino acids are diverted to the pathway of glucose generation and oxidation. If nutritional intake is not adequate, protein-energy malnutrition may happen insidiously. Recommended dietary allowance for proteins is 0.8 g per day with 10%-14% of calorie must come from proteins. Fat generate 9 kcal/ gm, carbohydrate & protein generate 4 kcal/ gm and ethanol provides 7 kcal/ gm - however, alcohol is not a source of nutrition[3, 13].

As the source of energy the fat intake should not be more than 30% of the total calories with limitation to the intake of trans fat, polyunsaturated fat and saturated fat to less than 10% of total. Some tissue like brain and Red Blood Cells (RBC) depends on indigenous or exogenous supply of glucose; as a result, 45%-55% of total daily calorie should be derived from the carbohydrates[14]. The brain requires ~100 gm of glucose per day as fuel, while other tissue uses ~50 gm per day. Normally for adults, 1-1.5 ml of water per kilogram of energy consumed is sufficient to allow for sweating, solute load and physical activity[15].

Physiological changes leading to dietary imbalance

Ageing can be defined as an accumulation molecular defects that build up within tissues and cells causing age related functional impairment of organs and tissues. Many genes contribute to ageing but to a limited extent. The genetic factors account for only 25%, whereas environmental and nutritional factors determine the rest of life span. Random molecular damage results from reactive oxygen species produced during the cellular energy generation and have a major role to play in ageing process[16].

Inter-individual variation in organ functioning is seen with ageing and this remains the basis of the differences seen in biological ageing versus chronological ageing. Some individuals show little or no change in functioning of physiological processes, while others show marked deterioration of function. This heterogeneity is a hallmark of ageing, and is the basis of personalized medicine in geriatrics. Habits, life style and environmental factors like alcohol misuse, socio-economic factors, cigarette smoking, and lack of exercise are responsible for the heterogeneity seen in older adults[17]. Ageing by

itself do not interfere with organ function under normal conditions, but depletes the reserve capacity in significant way and forms the basis of frailty seen in elderly population[18].

Frailty-Disability-Comorbidity interplay[27]

It is important to understand the difference between frailty, disability, and comorbidity as they are inter-related concepts that significantly affect the health and quality of life in older adult. Severe malnutrition is a disorder that results from the interplay of three distinct but related processes, each of which appears to be related directly to the food consumed, but none of which can be easily understood by consideration of food alone. These factors are:-

1) Inflammation and immune response
2) Specific nutrient deficiencies
3) Reductive adaptation

Frailty: - The sum of these above mentioned processes results in frailty which is defined as the inability of the older adult to cope-up with the minor stresses of life due to depleted reserves in the functioning of several organ systems all at the same time. The life stresses which are trivial for a fit old person of the same age causes severe organ failure and death in frail older adult[19].

In other words, frailty is clinical syndrome characterized by a decrease in an individual‘s physiological reserve and increase vulnerability to stressors. It is often associated with ageing and can lead to adverse health outcomes like falls, hospitalization, disability and mortality. The characteristics of frailty includes:-

1) Physical decline: - Frailty is marked by weakness, slow walking speed, low physical activity exhaustion, and un-intentional weight loss.
2) Biological changes: - It involves changes at the cellular and molecular levels, such as inflammation, hormonal changes, and mitochondrial dysfunction.
3) Clinical assessment: - Tools like the Frailty Phenotype (Fried‘s criteria) and Frailty index (accumulation of deficit model) and performance oriented mobility assessment (POMA) are used for assessment.

4) Reversibility: - Frailty is potentially reversible, especially in its early stages, through interventions like exercise, nutrition, and management of chronic diseases.

Fried frailty score[27]
1) Hand-grip strength in bottom 20% of healthy elderly population 2) Walking speed in bottom 20% of healthy elderly distribution 3) Physically inactive 4) Self-reported exhaustion 5) At least 6 kg weight loss within 1 year
Patient is defined as frail if 3 or more factors are present.
Varies between populations. Grip cut-off is 30 kg for men, 18 kg for women in US adults; 5 m walk time cut-off is 7 seconds in US adults for both sexes.

Table No.1 Fried frailty score

Disability: - Disability refers to established loss of function, impairments, activity limitations, and participation restrictions that affect an individual‘s ability to perform activities of daily living (ADL). In older adults, it often results from a combination of chronic diseases, frailty, and age related changes. Various characteristics of disability are:

1. Impairments: - Physical impairments such as loss of vision, hearing, or mobility and cognitive impairments like dementia.
2. Activity limitations: - Difficulty in performing basic activities of daily living (ADLs) such as bathing, dressing, eating, and instrumental activities of daily living (IADLs) like managing finances, transportation, and medication.
3. Impact on quality of life: - Disability can significantly reduce the quality of life and independence, increasing the need for assistance and long term care.

Comorbidity: - Comorbidity refers to presence of two or more chronic diseases or conditions in an individual simultaneously. It is common in older adults due to ageing process and due to accumulation of health issues over time. It is possible to have several

diagnoses in an individual without major impact on homeostatic reserve. Characteristics of comorbidity are: -

1. Multiple conditions: - Common comorbid conditions include hypertension, diabetes, arthritis, cardiovascular diseases, and chronic respiratory diseases.
2. Interactions and complexity: - Comorbid conditions can interact in a complex ways, complicating diagnosis, treatment, and management.
3. Impact on health outcomes: - Comorbidity increases the risk of adverse outcomes, such as hospitalization, disability, and mortality.
4. Management challenges: - Comorbid conditions require a comprehensive and often multidisciplinary approach to manage the multiple medications, potential drug interactions, and the overall burden of disease.

It is equally important to understand the **inter-relationships** among the three entities: -

1. **Frailty and comorbidity**: - Frailty often coexists with comorbidity, as multiple chronic diseases can lead to physiological decline and vulnerability.
2. **Disability and comorbidity**: - Chronic diseases can cause impairments that lead to disability. For instance, arthritis can cause joint pain and mobility issues, resulting in disability.
3. **Frailty and disability**: - Frailty increases the risk of disability due to reduced physical and cognitive reserves. Conversely, disability can exacerbate frailty by limiting physical activity and social engagement.

It is also important to understand the **clinical implications** of frailty, disability and comorbidity: -

1. **Holistic assessment**: - Health professionals needs to adopt a holistic approach, considering frailty, disability and comorbidity together, to develop effective care plans for older adults.
2. **Personalized interventions**: - Interventions should be personalized, addressing the specific needs and conditions of the individual, including physical therapy, medication management, and social support provided to the elderly person.

3. **Preventive measure**: - Emphasis on preventive measures, such as regular exercise, healthy diet, and management of chronic conditions, can help mitigate the progression of frailty, disability, and comorbidity.

Understanding these concepts is crucial for improving the health and well-being of older adult, enabling them to maintain independence and a better quality of life together with better health related quality of life (HRQOL) [20, 27].

Defining malnutrition in geriatric population

Malnutrition in the geriatric population is a critical health issue characterized by an imbalance between nutritional intake and the body‘s requirements leading to an adverse effect on the body composition, physical function, and clinical outcomes. It can manifest as under-nutrition marked by deficiency of calories, protein, or other essential micro or macro nutrients or over-nutrition which is marked by excessive intake of nutrients, calorie and leading to obesity[21]. Though, malnutrition symbolizes both the under and over nutrition, but for the convenience in this research, malnutrition refers to under-nutrition as it is more prevalent in our country especially in elderly population. Moreover, critically ill patients with respiratory diseases admitted n critical care unit are at increasing risk of malnutrition related complications causing delay in their recovery[22].

Definition of malnutrition: -Malnutrition in older adults is defined as a condition where there is a deficiency, excess, or imbalance of energy, protein and other nutrients, causing measurable adverse effects on tissue morphological form, function, and clinical outcome. It is often assessed using various tools and diagnostic criteria requiring an inter-disciplinary team approach[23].

ASPEN defines malnutrition as ‒An acute, sub-acute or chronic state of nutritional imbalance, in which a combination of varying degrees of over-nutrition or under-nutrition with or without inflammatory activity has led to a change in body composition and diminished function‖. The three etiology-based nutrition diagnoses in adults in clinical practice settings are:-

- **"Starvation-related malnutrition"**: usually without inflammation example is anorexia nervosa mostly seen in young girls and is associated with body dysmorphic syndrome.

- **"Chronic disease-related malnutrition"**: with mild to moderate degree of inflammation examples include rheumatoid arthritis, organ failure, Sarcopenic obesity in elderly or pancreatic cancer.
- **"Acute disease or injury-related malnutrition"**: with acute or severe inflammation in conditions such as major infection, trauma related closed head injury or burns injuries.

ESPEN definition[24] of "at risk of malnutrition":- Older adults should be screened for malnutrition at presentation if any one of the following criteria is found positive:-

1. Un-intentional weight loss of 10% of body weight in 6 months or 5% in past one month.
2. BMI ≥ 25 kg/m^2 $^{or} \leq 18.5$ kg/m$^{2.}$
3. Older adult has a diagnosis of a chronic disease.
4. Metabolic requirements increased in elderly.
5. Presence of conditions causing altered diet schedule.

Phenotypic criteria for the diagnosis of malnutrition includes: -

1. Significant weight loss of >10% beyond 6 months or >5% in past 6 months.
2. BMI of older adult <20 kg/m^2 if <70 years, or <22 kg/m^2 if >70 years of age.
3. Fall in muscle mass checked by validated tool.

Etiologic criteria for the diagnosis of malnutrition includes: -

1. Intake of less than 50% of daily energy requirement for more than one week or reduced appetite for more than 2 weeks.
2. Presence of inflammation due to acute or chronic health condition.

Global leadership initiative on malnutrition (GLIM) proposed that age is a risk factor for malnutrition and is usually associated with acute or chronic disease conditions like Osteoporosis and Sarcopenia. The risk of malnutrition according to GLIM study increases many folds if catabolic state exists with weight loss of more than 5% in six months or the

person has low BMI of less than 20 kg/m^2, which as per GLIM criteria requires dietary interventions.

Prevalence of malnutrition

As per the India ageing report-2023, in India, 27.1% older adults were underweight, while 16.8% were obese. With the increase in age, the incidence of underweight older persons increases, substantially, among both men and women. Incidence of underweight men aged 60 and above was 28.7%, and incidence of underweight women aged 60 and above was 25.7%. The incidence of obesity among urban elderly was 11.8% in comparison to 3.2% of rural elderly[1, 25].

Causes of malnutrition in older adults

Various causes of malnutrition in elderly population is enlisted as follows:-

1. **Physiological changes with advancing age**: - Anorexia of aging is described as decreasing appetite due to various factors due to advancing age such as dental issues and difficulty chewing or swallowing as the age advances. Senile changes with taste and smell plays an important role in appetite and ease of food intake. Other changes include changes in digestion and absorption of the ingested food due to gastro-intestinal system changes.

2. **Chronic diseases associated with advancing age**: - Conditions like heart disease, diabetes, chronic obstructive disease (COPD), and cancer can affect nutrient intake and metabolism.

3. **Phycho-social factors**: - Depression, loneliness and social isolation is common in elderly population and can lead to decrease appetite and food intake. Cognitive impairment and dementia can result in forgetting to eat or inability to prepare meals result in malnutrition.

4. **Socio-economic factors**: - Limited financial resources can affect the older person‘s ability to purchase nutritious foods for his consumption. Lack of access to healthy foods due to transportation issues or living in a surrounding where food is not readily available can lead to reduced food intake and thus causes malnutrition.

5. **Functional decline:** - Physical disability and frailty can make it difficult to shop for food, cook, eat and feed oneself.

Various consequences of malnutrition in older adults

1. Effect of malnutrition on physical health: - Due to prolong malnutrition, there is muscle wasting causing loss of muscle mass, muscle quality, muscle strength and muscle function which is termed as Sarcopenia. There is associated decrease bone density and increased risk of fractures. Malnutrition causes weakened immune system, leading to higher susceptibility to infections with delayed wound healing and prolonged duration of illnesses[26].

2. Effect of malnutrition on functional decline in older adult: - Malnutrition and risk of malnutrition result in reduced mobility and independence of the older person finally resulting in poor quality of life of the older adult. There is also increased risk of falls and injuries. There is impaired cognitive function due to severe malnutrition with exacerbation of dementia symptoms in longer run[27].

3. Physiological effects of malnutrition: - with malnutrition there is increased risk of depression and anxiety among elderly population. There is social withdrawal due to poor nutrient intake and decreased quality of life.

4. Clinical outcome in malnutrition: - Malnutrition results in higher rates of hospital admissions and longer hospital stays with increased morbidity and mortality.

Assessment and diagnosis: - Malnutrition in older adults can be assessed using various screening tools and diagnostic criteria brief description of some of them are as follows[69]: -

1. Mini nutritional assessment (MNA®): - MNA® is a widely used tool that includes questions on dietary intake, weight loss, mobility, psychological stress, and body mass index (BMI).

2. Malnutrition universal screening tool (MUST): - MUST include BMI, unplanned weight loss, and acute disease effect.

3. Subjective global assessment (SGA): - SGA is based on medical history and physical examination.

4. Diagnostic criteria: - The global leadership initiative in malnutrition (GLIM) criteria include phenotypic criteria (As mentioned in the section above)and includes history of unintentional weight loss, low BMI, and reduced muscle mass. The etiological parameters of GLIM criteria include reduced food intake and assimilation, disease burden and prevalence of inflammatory conditions[69]. (Annexure-II)

Management and treatment of malnutrition: - Managing of malnutrition in older adults requires a comprehensive and multi-disciplinary approach which includes: -

1. Nutritional interventions in terms of dietary modifications: - Tailoring meals to individual preferences and dietary needs, enhancing flavour, and providing nutrient-dense foods.

2. Oral nutritional supplements (ONS): -High calorie, high protein supplements can be useful for those unable to meet their nutritional needs through food alone.

3. Enteral and parenteral nutrition: - In severe cases, tube feeding or intravenous nutrition may be necessary.

Addressing the underlying causes of malnutrition: -

1. Medical management: - Treating underlying chronic conditions and managing medication side effect is of paramount importance.

2. Dental care of the patient: - Addressing dental issues that affect chewing and swallowing could be the first step in the management of malnutrition in older adults.

3. Psychological support: - Providing mental health support, social engagement activities, and addressing loneliness and isolation is the way to cheer the elderly so that it becomes his motivation to start eating frequent healthy meals.

4. Monitoring the follow-up: - Regular monitoring of nutritional status, weight, and functional outcomes is imperative in correcting malnutrition. Adjusting nutritional plans based on changes in health status and needs does wonders.

Strategies for the prevention of malnutrition: -

1. Education and awareness: - Educating older adults, caregivers, and health care providers about the importance of nutrition has lasting impact on nutritional correction in elderly population.

2. Policy interventions: - Ensuring policies that support access to nutritious foods for older adults helps.

Conclusion: - Malnutrition in the geriatric population is a multifaceted problem that requires timely identification and a holistic approach to management. Addressing nutritional needs in older adults can significantly improve their health outcomes, quality of life, and independence[28].

Nutritional assessment of older adult

In order to identify nutrition-related problems, it is imperative to do nutritional related screening and assessment. To determine the nutritional status of an individual, it is important to take in-depth history and focused physical examination which is usually done by a qualified and trained physician or dietician[29]. The information obtained is used to formulate a nutritional correction plan for a quick recovery of the older adult. It is important to consider various environmental, social, physical, and medical factors to analyse nutritional status and to evaluate nutritional requirement of an individual[30].

Nutrition-related history taking

Dietary choices can be identified while evaluating elderly for nutritional assessment. The pattern of food consumption can be the first step in nutritional history taking. Following points must be included while taking dietary history: -

1. Food preferences like vegetarian or mixed diet
2. Appetite if it is normal or reduced
3. History of unintentional weight loss
4. Issues with denture, oral hygiene, ease of chewing and swallowing
5. Any constipation or altered bowel habits
6. Prevalence of any nausea or vomiting
7. Any dietary restrictions like lactose intolerance including food allergies
8. Level of functional independence for ADL and IADL
9. Exercise, sports and daily activity level

10. Use of prescription drugs that causes anorexia

Subjective evaluation can be done by using food questionnaires, daily food diaries and daily recalls, but these are all subjective and depend upon the memory of the elderly individual and can't be relied too much[31].

Nutrition-focused physical examination

Physical examination can detect visible indicators of nutrition deficits in areas with rapid cell turnover, such as the hair, skin, mouth, and tongue. Signs of weight loss, including reductions in lean body mass and subcutaneous fat, require thorough investigation. It is crucial to monitor fluid retention, which can obscure weight loss. Additionally, findings like skeletal muscle depletion may indicate inflammation or systemic inflammatory response, particularly in older adults admitted to critical care units in hospitals[32].

Anthropometric measurements

Body compositions and measurements are unique for any individual and can give a glimpse of health, disease and nutritional status[33]. Body measurements defined as anthropometry includes body composition, height, weight, and also includes the measurement of: -

1. Measurement of waist circumference
2. Measurement of chest circumference both in inspiration and expiration
3. Measurement of body circumference
4. Measurement of arm span
5. Measurement of calf circumference
6. Measurement of mid-arm circumference

Waist circumference measurement

Waist circumference is a measure of abdominal fat, which is associated with increased risk of metabolic diseases. It is an essential anthropometric measurement for assessing central obesity and nutritional status in elderly person. It is measured by asking the person to stand still and relaxed with feet together, arms relaxed at the sides. Measurement is done at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest by using a flexible, non-stretchable measuring tape. The tape should be snug but do not compress the skin. Measurement is done at the end of expiration[34].

High waist circumference indicates excess abdominal fat, which is a risk factor for cardiovascular diseases, type-II diabetes and metabolic syndrome. It helps assess nutritional status, as central obesity is common among the elderly, especially in thosewith sedentary lifestyles or poor dietary habits. Research shows that increased waist circumference is associated with higher risks of morbidity and mortality, regardless of BMI[35].

waist circumference (in inches)	Women	Men
Asian origin	31	35
U.S. origin	35	40
Reference values- U.S. Department of Health and Human Services (HHS),and World Health Organization (WHO)		

Table no. 2- Waist circumference in Asian and U.S.A. population

Calf circumference measurement

Calf circumference measurement is a measure of muscle mass and nutrition status, particularly useful in elderly patients who may experience muscle wasting and loss of muscle quality and function (Sarcopenia) [36].

Calf circumference evaluation is an important anthropometric parameter for the screening, determination and assessment of the nutritional status of an elderly adult. Calf circumference is a practical and simple measure to assess muscle mass and detect sarcopenia[37]. It is especially useful in settings where more advanced body composition techniques are not available like the primary health centres of our country. Regular measurement of calf circumference can help in the early detection of malnutrition and sarcopenia, allowing for timely nutritional intervention, such as increasing protein intake, and resistance training exercises[38].

The patient should sit with their legs dangling freely or lie down in bed with their legs extended. The calf circumference is done at the widest part of the calf. A flexible, non-stretchable measuring tape is snug but not compressing the skin and is parallel to floor[39].

Calf circumference is a good proxy for overall muscle mass and strength, which is important for mobility and physical function. Decreased calf circumference can indicate malnutrition and Sarcopenia, common in elderly population due to inadequate protein intake, sedentary lifestyle, or chronic illness. Calf circumference correlates with physical

performance and functional status. Lower values indicate a need for interventions to improve muscle mass and strength to maintain mobility and independence as it is associated with higher risk of disability, falls, fractures and mobility[40].

A calf circumference of < 31cm is often used as a cut-off point to identify elderly individuals at risk of malnutrition and Sarcopenia. Whereas waist circumference focuses on fat distribution and central obesity, calf circumference focuses on muscle mass and potential Sarcopenia. Calf circumference is a valuable non-invasive tool for assessing the nutritional status of elderly patients[41]. It helps identify those at risk of malnutrition, Sarcopenia, and metabolic disorders, enabling timely interventions to improve health outcome and quality of life. Regular monitoring and a holistic approach to nutrition and physical activity are essential in managing and preventing the adverse effects of poor nutritional status of the elderly[42].

Mid arm circumference (MAC) measurement

Mid arm circumference (MAC) is an important and pivotal anthropometric measurement used to assess nutritional status, particularly in elderly. It provides into muscle mass, fat reserves, and overall health and wellbeing, making it a critical tool in identifying malnutrition related health risks[43].

Recent research highlights its significance in evaluating malnutrition, Sarcopenia, and related health outcomes. MAC is measured at the midpoint between acromion and the olecranon. It is a composite measure of the muscle mass and subcutaneous fat, providing a proxy for overall nutritional status.

The patient should sit or stand with arm relaxed and hanging loosely by the side. The midpoint between acromion and the olecranon is located, a non-stretchable measuring tape is wrapped around the arm at the pre-determined mid-point, ensuring it is snug but not compressing the skin. The measurement is done to the nearest centimetre and recorded.

MAC is an important component of nutritional screening in elderly age group, who are at the risk of Sarcopenia and senile change in fat distribution. MCA is widely used in screening for malnutrition, especially in resource-limited settings where more sophisticated methods are un-available. It provides a quick, non-invasive, and cost effective means of assessing the nutritional status. Regular measurement of MAC can

help track changes in nutritional status over time. This is crucial for monitoring the effectiveness of nutritional interventions, recovery from illness, or progression of chronic conditions[44].

Importance of MAC measurement in elderly patient admitted in ICU

Sarcopenia, the age related loss of muscle mass and function is a significant concern in elderly. MAC helps in the early detection of Sarcopenia, enabling timely interventions such as dietary modifications and resistance training to preserve muscle mass, quality, and functional status[45].

Malnutrition in elderly can lead to various adverse health outcomes, including increased susceptibility to infections, delayed wound healing, and higher mortality rates. MAC serves as a reliable indicator of nutritional status, helping healthcare providers identify individuals at risk of malnutrition and implement appropriate interventions. MAC correlates with functional status and physical performance in the elderly. Lower MAC values are associated with reduced strength, ability, and independence, highlighting the importance of maintaining adequate nutritional status for preserving functional abilities and quality of life[46].

MAC as screening tool for nutrition and health outcome: - A recent study demonstrated that low MAC is strongly associated with increased mortality and morbidity in elderly populations. The study, which includes over 3000 elderly participants, found that those with lower MAC values had significant higher risks of developing chronic diseases, experiencing hospitalizations and facing early mortality[47].

Another study established MAC as a reliable predictor of Sarcopenia in elderly patients. The study utilizes MAC measurements along-side other indicators like hand-grip strength and gait speed to assess Sarcopenia[48]. Result of the study indicated that lower MAC values were strongly correlated with reduced muscle mass and strength, reinforcing the importance of MAC in early detection and intervention[49].

Another study explored the impact of nutritional intervention on Mac in malnourished elderly patients[50]. The randomized controlled trial provided high protein, nutrient dense supplements to one group and standard care to another. Finding showed a significant increase in MAC in the intervention group, along with improvement in muscle strength and physical performance.

Impact of MAC on health outcome in elderly adult: - Lower MAC values are associated with higher morbidity and mortality rates in the elderly. Research indicates that MAC is a strong predictor of adverse health outcomes, emphasizing the need for routine nutritional assessment in geriatric care.

Research has conclusively proved that elderly patients with low MAC are more likely to experience complications during hospitalization, including longer stays and delayed recovery. Adequate nutritional status, as indicated by MAC, is essential for improving clinical outcomes and reducing the risks of complications[51]. Maintaining an adequate MAC is linked to better overall health and quality of life in the elderly. Proper nutrition supports physical, cognitive, and emotional well-being, enabling older adults to remain active and engaged in their communities[52].

Nutritional interventions with an aim to improve MAC in elderly: - Ensuring adequate protein intake is crucial for maintaining muscle mass. Protein rich foods such as lean meats, dairy products, legumes, and nuts should be included in the diet. Meeting caloric needs is essential to prevent muscle and fat loss. Nutrient dense foods and supplements can help achieve adequate caloric intake. Vitamins and minerals, such as vitamin D, calcium and B vitamins support muscle health and overall nutrition. A balanced diet with fruits, vegetables, and fortified foods can help meet these needs.

Physical activities with an aim to improve MAC in elderly: - Resistance exercises that build muscle strength and mass, such as weight lifting and resistance band exercises, are beneficial for increasing MAC. Aerobic exercises like walking, swimming, and cycling improve overall fitness and support muscle strength and muscle health. Flexible and balance exercises such as yoga and tai-chi enhance mobility and reduce the risk of falls, contributing to overall physical health[53].

Challenges and limitations of MAC: - While MAC is a useful tool, variability in measurement techniques and inter-observer differences can affect accuracy. Standardized training and protocols are essential to ensure consistent and reliable measurements. MAC provides a combined measurement of muscle and fat but does not differentiate between the two. Additional measurements, such as skinfold thickness or bioelectrical impedance analysis, may be needed for a more detailed evaluation of body composition. Cultural and ethical differences can influence body composition and MAC values. Reference

standards should be adjusted to account for these variations to ensure accurate assessment and interpretation[54].

Mid-arm circumference is a vital tool in the evaluation of nutritional status and the detection of malnutrition in the elderly. Its ease of use, cost-effectiveness, and correlation with health outcomes make it indispensable in clinical and community settings. By providing insights into muscle mass and fat reserves, MAC helps identify individuals at risk of malnutrition, Sarcopenia, and related health issues, enabling timely and targeted interventions[55]. MAC through proper nutrition and physical activity is crucial for preserving health, functionality, and quality of life in older adults. As the global population ages, the importance of MAC in geriatric care will continue to grow, highlighting the need for on-going research, education, and implementations of the best practices in the nutritional assessment and management of older adults[56].

Triceps skin-fold thickness measurement

Measurement of skinfold thickness assesses subcutaneous fat, assuming it constitutes 50% of total body fat. Typically, the triceps and subscapular skinfolds offer the most valuable insights. However, the reliability of skinfold thickness measurements depends on the precision of equipment and examiner technique, limiting their practical utility in acute care settings. The triceps skinfold (TSF) measurement, in conjunction with mid-upper arm circumference (MAC), is employed to compute the arm muscle area (AMA). MAC is measured at the midpoint between the acromion process of the scapula and the elbow tip[57]. These measurements reveal the amount of muscle mass available for protein synthesis and energy requirements. AMA changes over time can indicate protein or calorie deficiencies in the patient. It serves as an indicator of nutritional status and may predict mortality.

Body composition evaluation

Body composition refers to the distribution of body fat, muscle mass, and bone density in an individual. Even among people of similar height, variations in body weight can stem from differences in lean body mass, fat mass, and skeletal size. Various methods are employed to assess body composition, ranging from basic measurements like skin-fold thickness and mid-upper arm circumference to more advanced techniques such as bioelectrical impedance analysis (BIA) or dual-energy X-ray absorptiometry (DXA)

scans. These methods help determine ratios such as body fat to body mass, intracellular water to extracellular water, and bone density[58].

Pulmonary function evaluation and the BODE index for the progression of COPD

Malnutrition can alter pulmonary function test outcomes. Weakening of the diaphragm and other inspiratory muscles can decrease vital capacity and peak inspiratory pressures. The strength and endurance of respiratory muscles, especially the diaphragm, are affected. This weakness may impair the ability to cough effectively and clear secretions, potentially increasing the risk of pulmonary complications.

Dietary antioxidants are believed to shield tissues from oxidative damage by stabilizing reactive molecules. Oxidative stress plays a role in airflow restriction, making antioxidants crucial for pulmonary defence[59]. The progression of COPD involves periods of exacerbations that shift between long-term and acute care settings, contributing to rapid declines in lung function and increased medical demands. The prognosis of COPD is evaluated using the BODE Index, which incorporates body mass index (B) to assess nutritional status, FEV1 to gauge airflow obstruction severity (O), the Medical Research Council score to assess dyspnoea severity (D), and the 6-minute walk distance to evaluate exercise capacity (E)[17, 60].

Other body assessment tools

Advanced methods for measuring body composition include bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DXA), computed tomography (CT) scans, and magnetic resonance imaging (MRI). While these techniques are highly precise and non-invasive, they may not be optimal for routine clinical use due to their cost and time requirements.

Creatinine-height index

Since skeletal muscle produces Creatinine at a steady rate, the amount of Creatinine excreted in urine over 24 hours can indicate muscle mass and potential muscle loss. However, this measurement requires accurate urine collection and normal kidney function. Other factors like age, diet, exercise, stress, trauma, fever, and sepsis can also affect Creatinine levels, complicating the interpretation of this measure[61].

Body mass index or Quetelet index

Adolphe Quetelet (1796-1874) was a Belgian mathematician, astronomer, and statistician who developed a keen interest in probability calculus, applying it to study human physical characteristics and social aptitude. He observed that in humans, weight tends to increase proportionally to the square of height, a concept later termed the Quetelet index and eventually renamed body mass index (BMI) by Ancel Keys in 1972. BMI, rather than body weight alone, provides a more accurate measure of an individual's nutritional status by adjusting weight relative to height. However, BMI does not differentiate between individuals who have replaced muscle mass with fat tissue or distinguish those with central obesity, which is linked to adverse health outcomes. Some researchers argue that waist or calf muscle circumference may be more effective than BMI for assessing obesity in older adults[62]. Additionally, the loss of height due to bone density loss in the elderly limits BMI's utility in objectively evaluating nutritional status in this population. A healthy weight is typically defined by a BMI ranging from 18.5 to 24.9 in adults. Adults with a BMI of 25.0 to 29.9 are classified as overweight, while those with a BMI greater than 30 are considered obese[63]. Adults categorized as underweight have a BMI below 18.5.

BMI (kg/m^2)	**Classification based on BMI**	**Co-morbidity risk**
<16.0	Severe under-weight	Severe and frequent risk
16.0-16.9	Medium under-weight	Moderate to medium risk
17.0-18.5	Mild under-weight	Average risk of comorbidity
<18.5	Under-weight	Risk of clinical complications
18.5-24.9	Normal weight range	Average or no risk
25.0-29.9	Over-weight (pre-obese)	Acceptable range in elderly
30.0-34.9	Obesity Class I	Moderate risk of complication
35.0-39.9	Obesity Class II	Severe risk
≥ 40.0	Obesity Class III	Very Severe risks

Table no. 3- BMI categories and risk of co-morbidity risk

Biomarkers of inflammation

One of the most common biomarkers of inflammation used in clinical practice is C-reactive protein (CRP). CRP levels rise with infection and inflammation, alongside pro-inflammatory cytokines such as IL-1a, IL-1b, IL-6, and TNFα. As the levels of pro-inflammatory markers increases, the level of albumin and pre-albumin decreases. Other biomarkers of inflammation include prolactin, cholesterol, hyperglycemia, and ferritin. Albumin, which makes up the majority of protein in plasma, is commonly measured. Its half-life of 14–20 days reduces its usefulness for monitoring the effectiveness of nutrition in acute care[17, 64]. However, the general availability and day-to-day stability of albumin levels make it a common test for assessing long-term trends and providing a general idea of baseline nutritional status before a procedure, injury, or acute illness. Albumin levels often reflect the metabolic response and severity of disease, injury, or infection, making it a useful prognostic indicator[8, 10, 65]. Albumin synthesis is influenced by both nutrition and inflammation. During inflammation, albumin production decreases. Low albumin levels due to inflammation are linked with increased morbidity, mortality, and longer hospital stays. Transferrin, an acute-phase reactant and iron transport protein, has a half-life of 8–10 days, making it a better indicator of improved nutritional status than albumin. However, its levels can be affected by iron deficiency and various factors such as liver and kidney disease, inflammation, and congestive heart failure. Transthyretin (pre-albumin) and retinol-binding protein have shorter half-lives of 2-3 days and 12 hours, respectively, allowing them to respond to nutritional changes more quickly than albumin or transferrin. Despite this, their levels are influenced by many metabolic conditions, diseases, therapies, and infections. Like albumin, their usefulness is limited during stress and inflammation. Because these conditions are common in critically ill patients, visceral protein markers are less helpful for assessing nutritional deficiency but are more important for evaluating illness severity and the risk of future malnutrition[10, 66].

Differentiation of Catabolism in Critical Illness from Starvation

One fundamental difference between the two conditions is that in the former, the basal metabolic rate (BMR) is elevated, whereas in the latter, it is decreased. Ketogenesis is a prominent feature of starvation but is not associated with critical illness[67].

Feature	Critical illness	Starvation
BMR/REE	Increased	Decreased
Respiratory Quotient	0.8-0.9	0.6-0.7
Cytokine levels	Increased	Decreased
Primary body fuels	Mixed	Fats
Proteolysis	+++	+
Urea genesis	+++	+
Urinary Nitrogen losses	+++	+
Gluconeogenesis	+++	+
Ketone production	+	+++

BMR: Basal Metabolic rate; REE: Resting energy expenditure; ↑: Increases; ↓: Decreased; +: Present; +++: strongly present

Table4. - Catabolism in critical illness versus starvation

Various screening tools for the assessment of malnutrition (Annexure-II)

The Comprehensive Geriatric Assessment

The Comprehensive Geriatric Assessment (CGA) is a multidimensional, multidisciplinary diagnostic process used to identify medical, functional, and psychosocial problems and capabilities in elderly patients at risk for functional decline. CGA begins with a screening process using simple, rapid, inexpensive, and internationally validated scales to evaluate cognitive function, functional status, walking, balance, and socio-economic status. The revision and validation of the MNA-SF® as a stand-alone screening tool in 2009, has enabled clinicians to quickly identify those who are malnourished or at nutritional risk in less than 5 minutes[8, 10, 68].

Overall Elements of Comprehensive Geriatric Assessment:

1. **Physical Health:** The medical history focuses on medication use and risks for malnutrition, falls, incontinence, and immobility. The physical examination aims

to identify diseases or conditions that may benefit from curative, restorative, palliative, or preventive treatments. Special attention is given to visual or hearing impairments, nutritional status, and conditions contributing to frailty, falls, or mobility difficulties.

2. **Mental Health:** Cognitive, behavioural, and emotional statuses are evaluated, with particular emphasis on detecting dementia, delirium, and depression.

3. **Social and Economic Status:** This includes the social support network, availability and competence of caregivers, the elderly person's economic resources, and other sources of support such as cultural, ethnic, and spiritual resources. It also includes the individual's self-assessment of quality of life.

4. **Functional Status:** Functional status is measured by the ability to perform basic activities of daily living (ADLs) and participate in instrumental activities of daily living (IADLs). ADLs include bathing, dressing, toileting, transferring, continence, and feeding. IADLs require higher cognitive and judgment skills and include meal preparation, shopping, light housework, financial management, medication management, transportation use, and telephone use.

5. **Environmental Characteristics:** Evaluating the patient's physical environment determines the safety of the living conditions and assesses the patient's access to essential services such as shopping, pharmacy, family support, social support, and ease of using transportation.

Mini nutritional assessment- short form (MNA-SF) ® (Annexure-II)

Mini nutritional assessment- short form (MNA-SF®) is a widely used tool for the evaluation of nutritional status, particularly in elderly populations. The detailed over view of MNA-SF® ‘s importance in assessing nutritional status and predicting outcome in elderly ICU patients with respiratory diseases and a brief historic background of it is as follows:-

Historical background of MNA-SF®

MNA questionnaire was conceptualized and developed by Dr. Pierre Guigoz in the late 1990‘s, a Swiss Geriatritian, who created the MNA as a screening tool specifically designed to assess the nutritional status of older adults, particularly those in healthcare

settings such as hospital and nursing homes[10, 69]. The historical background of NMA questionnaire includes the following:

The aim of developing the MNA® begin in late 1990‘s with the goal of creating a practical and reliable tool to identify malnutrition and identify those patients who are at the risk of developing malnutrition early. Dr. Guigoz recognizes the importance of addressing malnutrition in the elderly as it is a common issue among older adults and can have significant adverse effects on the health and wellbeing[69]. MNA® was designed to be comprehensive assessment tool, taking into account various aspects of nutritional health, including dietary intake, weight loss, mobility, psychological stress and anthropometric parameters[70].

To save time in screening, Rubenstein et al. developed a shortened version, the Mini Nutritional Assessment-Short Form (MNA-SF®), in 2001 and created a two-step screening process. The MNA-SF® consists of six questions with the strongest correlation from the original MNA®. This short form was validated in the ambulatory care setting as a quicker way to screen large groups and eliminated the need to complete the full when a person was normally nourished. If the MNA-SF® classified a person as at risk, the full 18-question MNA had to be completed to determine if the person was truly malnourished.

Revised MNA-Short Form®

To further streamline the MNA® and make it more clinically applicable, researchers revised and revalidated the MNA-SF® using pooled data from 28 previously published studies. The new MNA-SF® incorporates the three cut-off points for nutritional status from the full MNA®, allowing identification of malnutrition with just six questions. It also includes an option to substitute calf circumference for BMI when BMI is not available. With these revisions, the new MNA-SF® is a stand-alone screening tool, eliminates the need for the longer full MNA®, and reduces screening time to less than five minutes[71].

Indications for the Application of MNA-SF®

- The revised MNA-SF® facilitates easier intervention and is now the preferred form of the MNA® for clinical use.

- The full MNA® remains useful in research settings and can also be used for a more in-depth screening.

1) **Quick and easy screening**: -The mini nutritional assessment-short form (MNA-SF®) is a widely used tool for the evaluation of nutritional status, particularly in elderly populations. It is brief and simple screening tool that can be administered quickly, making it particularly in the ICU setting where time is often limited. It consists of six questions related to dietary intake, weight loss, mobility, psychological stress and neuropsychological problems, along with body mass index of measurement of calf circumference. Despite its brevity, the MNA-SF® provides valuable insights into the nutritional status of the elderly person.

2) **Comprehensive assessment**: -Despite its simplicity, the MNA-SF® provides a comprehensive assessment of nutritional status by considering multiple dimensions of health, including dietary intake, anthropometric measurements, mobility, and psychological factors. This holistic approach allows clinicians to identify not only malnutrition but also risk factors and functional impairments that may impact nutritional status and overall health outcome.

3) **Predictive validity**: -The MNA-SF® underwent rigorous validation and refinement process to ensure its reliability and validity in assessing the nutritional status of older adult. Numerous studies have demonstrated the predictive validity of the MNA-SF® in identifying malnutrition and predicting adverse outcomes in elderly populations. In the context of elderly ICU patient with respiratory diseases, the MNA-SF® can help identify patients at risk of poor clinical outcomes, such as prolonged hospital stay, increased morbidity, and mortality. By identifying malnutrition early, clinicians can intervene with appropriate nutritional support strategies to improve outcomes.

4) **Tailored intervention**: - The MNA-SF® provides a basis for tailored intervention strategies based on the specific nutritional needs and functional status of individual patients. For example, patients identified as malnourished or at risk of malnutrition may benefit from early initiation of nutritional support, such as dietary modifications, oral nutritional supplements, enteral or parenteral nutrition. By addressing nutritional deficits promptly, clinicians can optimize patient outcomes and enhance recovery in elderly ICU patients with respiratory diseases.

5) **Integration into clinical practice**: - The MNA-SF® is endorsed by various professional organizations, including the European Society for Clinical Nutrition and Metabolism (ESPEN), as a valuable tool for nutritional assessment in elderly populations. Its wide spread use and acceptance make it easily integrated into clinical practice, facilitating routine screening of nutritional status in elderly ICU patients with respiratory diseases and enabling timely interventions when needed.

6) **Global adoption**: - Over the years, the MNA-SF® gained wide spread recognition and adaption in the field of Geriatric nutrition. It has been translated into multiple languages and is used internationally in various health care settings.

7) **Version and updates**: -Since its inception, the MNA® has undergone updates and modifications to improve its accuracy and relevance. Different versions of MNA® exists, including the original MNA®, The MNA-SF® , and MNA-full form, each tailored for specific application and settings. MNA® and MNA-SF® are quick and easy and straightforward to administer in hospital settings.

8) **Research and epidemiology**: - The MNA-SF® is valuable in research and epidemiological studies to assess the prevalence of malnutrition and its impact on various populations. It provides standardized data that can be compared across different studies and populations while doing statistical analysis.

9) **Impact on nutritional care**: - The MNA-SF® has had a significant impact on the field of nutrition for older adults. It has helped healthcare professionals identify individuals at risk of malnutrition early allowing for timely interventions and improved patient outcomes. Today, the MNA-SF® remains a valuable tool in the assessment and management of nutritional status in older adults. Its history reflects a commitment to addressing the nutritional needs of ageing population and improving the quality of care provided to older individual in critical care settings.

10) **Holistic assessment**: - The MNA-SF® and MNA consider not only the physical aspect but also psychological and social factors, recognizing that nutrition is influenced by more than just dietary intake. This holistic approach is particularly relevant for the elderly who may face unique challenges related to ageing.

In conclusion, the MNA® questionnaire is a valuable tool for assessing nutritional status, especially in older adults. Its comprehensive approach, ease of use, and ability to identify

malnutrition risk makes it an essential tool for health care professionals to ensure that individual elderly patients admitted to ICU with respiratory diseases will receive appropriate nutritional care and support for quick and early recovery and discharge.

Validity of MNA-SF®

Validity refers to how well a tool measures what it is supposed to measure. Screening tools should be validated for the specific population, setting, and condition they are intended to assess.

Advantages of Using a Validated Tool:

1. More accurately identifies clients who truly need help.
2. Reduces the likelihood of missing those who need intervention.
3. Minimizes wasting resources on those who don't need intervention.
4. Demonstrates effectiveness through positive health outcomes.

Importance of Validity When Selecting a Screening Tool: Validity is crucial because it ensures the tool accurately measures the condition in a specific population. Valid tools detect those who truly have the condition. Validity is assessed by **sensitivity** and **specificity**, and by predictive values ranging from 0–100%.

- **Sensitivity**: Measures how effectively the tool detects a condition in those who have it. A higher sensitivity means fewer cases go undetected[73].
    - MNA®: 96%
    - MNA-SF® : 98%
- **Specificity**: Measures how well the tool gives negative results for those without the condition. Higher specificity means fewer healthy individuals are incorrectly identified as at risk.
    - MNA®: 98%
    - MNA-SF® : 100%

- **Positive Predictive Value**: Indicates how many subjects who test positive actually have the condition.
- **Negative Predictive Value**: Indicates how many subjects who test negative truly do not have the condition.

Reliability ensures consistent results across different investigators when repeated in the same subjects[72].

The MNA is the well-validated screening tool for the elderly. The original validation study of the full MNA showed a sensitivity of 96%, specificity of 98%, and positive predictive value of 97% compared to clinical status. The original MNA-SF® had a sensitivity of 98%, specificity of 100%, and diagnostic accuracy of 99% for predicting under-nutrition. The recently revised MNA-SF® has sensitivity and specificity almost identical to the original MNA-SF®, confirming its validity and strong performance against the full MNA[73].

Nutritional Risk Screening-2002[73] (NRS-2002) - (Annexure-II)

The NRS-2002 was developed in 2002 by Kondrup et al., along with an ESPEN working group. It is the preferred tool for screening malnutrition in European hospitals, aiming to identify patients who could benefit from nutritional intervention[73]. This tool was created by evaluating the nutritional criteria, characteristics, and clinical outcomes of randomized controlled trials (RCTs) retrospectively. It assumes that indications for nutritional support include both the severity of under-nutrition and the increased nutritional requirements due to disease severity[74]. Therefore, it includes patients who are not currently malnourished but are at risk due to their disease and required treatments, such as chemotherapy, which can induce anorexia and increase stress metabolism, raising the risk of malnutrition[73].

The degree of disease severity and under-nutrition was categorized as mild, moderate or severe from RCT datasets and converted into a numeric score on the screening form. The NRS-2002 is a simple tool designed to identify patients at risk of malnutrition based on factors like weight loss, BMI, and disease severity. It has been validated in various patient populations, including elderly ICU patients with respiratory diseases. A study by Fiore et al. (2018) showed its effectiveness in predicting nutritional risk and clinical outcomes in this subset of elderly patients[75].

The tool is based on a review of 275 studies reporting the effectiveness of nutritional intervention. Its predictive validity was assessed against 128 RCTs of nutrition support, including a total of 8,944 patients. Researchers classified patients within each trial by nutritional status and disease severity and then determined the effect of nutritional intervention on clinical outcomes[10, 76]. Positive effects included reduced rates of infections and complications, improved mobility, and shorter hospital stays, but excluded improvements in nitrogen balance, liver function tests, or biochemical tests. The analysis indicated that patients at nutritional risk were more likely to benefit from nutritional intervention than those not at risk. The study also showed that the elderly had an increased benefit from nutritional support or an increased susceptibility to malnutrition risk. To account for this, a score of one (0.5 for nutritional status and 0.5 for disease severity) was added to all individuals aged 70 and older, recognizing advanced age as an additional risk factor for malnutrition[76].

The tool's content validity was enhanced through collaboration with an ESPEN ad hoc working group under the guidance of the ESPEN Educational and Clinical Practice Committee during literature-based validation.

Despite its original purpose to identify patients who would benefit from nutritional intervention, the NRS-2002 is often used to assess a patient's nutritional status without categorizing the level of malnutrition risk. Patients with chronic diseases admitted due to related complications receive a score of one, indicating increased protein requirements that can be met through oral diet or nutrient supplements. Patients who are immobile after procedures like abdominal surgery or stroke, with significantly increased protein needs requiring supplementation or enteral feeding, are scored as two. Critically ill patients, such as those requiring ventilation due to head injuries, receive a score of three; however, they were excluded from this study[77].

Calculation and Application of Scores

A total score is computed based on the final screening results for each patient. For patients aged 70 years and older, an additional point is added to adjust for age. If the age-adjusted score is three or more, the patient is considered nutritionally 'at risk,' requiring initiation of a nutritional care plan. If the final score is less than three, the patient should be screened weekly.

The Subjective Global Assessment- (Annexure-II)

The Subjective Global Assessment (SGA) tool was introduced by Baker et al. in 1982 to evaluate surgical patients for malnutrition directly at the bedside, bypassing the need for precise body composition, anthropometric measurements, or specific laboratory values like total lymphocyte count and albumin, which were conventionally required at the time[73]. It systematically assesses a patient's nutritional status, categorizing them as well-nourished, moderately malnourished, or severely malnourished. Despite its name, the SGA is primarily a screening tool rather than a comprehensive assessment. It is highly regarded for its patient-centred approach, relying on medical history and physical examination, and its association with clinical outcomes such as length of hospital stay, complications, infections, and wound healing. The final rating from SGA does not mandate nutritional intervention. Although subjective, the SGA has been validated and proven reliable in identifying malnutrition, particularly in ICU patients[78]. A recent study demonstrated the efficacy of SGA in predicting outcomes and identifying malnutrition in elderly ICU patients with respiratory diseases.

The initial validation of SGA involved two clinicians assessing 109 gastrointestinal surgery patients, showing strong correlation between subjective and objective measurements. Despite variability between assessors, it demonstrated robust inter-rater reproducibility (k=0.784). SGA is often considered the gold standard for nutrition screening and is recommended by ESPEN for further nutritional assessment.

Components of SGA

SGA consists of two main parts: a medical history and a physical examination. During the medical history, the patient's weight change over the past six months and two weeks is assessed, along with dietary intake, presence of gastrointestinal symptoms, and functional impairment through direct questioning. The clinician compares the patient's current dietary intake to their usual habits and determines if it is normal or abnormal. The duration and severity of any abnormal eating patterns are also evaluated, including whether the patient was fasting, on low-calorie fluids, full fluid diet, or suboptimal solid diet. Persistent gastrointestinal symptoms occurring daily for two weeks or more are considered significant[78, 80].

Functional capacity is also assessed, noting any dysfunction and its duration and type, which is a unique aspect compared to other screening tools.

The physical examination component focuses on objective signs of malnutrition. The clinician assesses for loss of subcutaneous fat in the triceps area, muscle wasting in quadriceps and deltoids, and the presence of ankle oedema, sacral oedema, or ascites. Each finding is graded subjectively on a scale from 0 to 3 (0: normal, 1: mild, 2: moderate, 3: severe) based on clinical judgment.

The final SGA score does not rely on a numerical sum but on a subjective rating of A, B, or C:

- A: Normally nourished
- B: Moderately malnourished (at risk of malnutrition)
- C: Severely malnourished (poor nutritional status)

Respiratory Pathologies

Age-related changes in respiratory system

Age-related changes in respiratory function contribute significantly to the burden of respiratory diseases, such as tuberculosis and pneumonia, which are major causes of illness and death across all age groups worldwide. As people age, their respiratory system experiences reduced reserve capacity, although normal breathing is minimally affected. This decline in reserve capacity makes older individuals less able to fight acute respiratory diseases effectively[17, 81]. For instance, there is a gradual decrease in FEV_1 (forced expiratory volume in one second) and the FEV_1/FVC ratio (forced vital capacity), which falls by about 0.2% per year after reaching 70% around the ages of 40 to 45 years. This decline is attributed to reduced elastic recoil in the small airways, a process accelerated approximately threefold by smoking[82].

Symptoms typically arise when FEV_1 drops below 50% of predicted levels. Age-related changes also lead to ventilation-perfusion mismatch due to decreased elastic recoil, causing small airways to collapse more readily during exhalation, especially in the lower lung regions, thus reducing ventilation efficiency. Older individuals also exhibit a diminished ventilatory response to low oxygen (hypoxia) and high carbon dioxide

(hypercapnia) levels, resulting in less rapid breathing (tachypnea) compared to younger individuals experiencing similar changes in blood oxygen and carbon dioxide levels[17, 83].

Aging also weakens the body's defences against infections due to fewer glandular epithelial cells, which are responsible for producing protective mucus. Furthermore, declines in muscle function, respiratory capacity, and cardiovascular function collectively reduce maximum oxygen uptake and overall exercise capacity, diminishing cardiorespiratory reserves[8, 10, 17].

Additionally, age-related changes include reduced chest wall compliance due to narrowing of intervertebral disc spaces and ossification of costal cartilages. Respiratory muscle strength and endurance also decline with age, although these changes typically become clinically significant only when coupled with other respiratory conditions[84].

Neutrophils, crucial in lung inflammation and pathogen clearance, undergo notable changes with age. They play pivotal roles in various inflammatory lung diseases such as ARDS, COPD, cystic fibrosis, idiopathic pulmonary fibrosis, bronchiectasis, and asthma[17, 85]. Neutrophils transition from pro-inflammatory roles to anti-inflammatory roles following successful resolution of inflammation, and switching from releasing inflammatory mediators like leukotriene-B4, platelet-activating factor, and IL-8, to producing resolving mediators such as lipoxins and resolvins that aid in inflammation resolution.

With advancing age, neutrophil function undergoes significant alterations, including reduced chemotaxis (ability to move toward chemical signals), phagocytosis (ability to engulf pathogens), and bactericidal mechanisms (ability to kill bacteria). These impairments increase susceptibility to infections and contribute to lung tissue damage due to release of neutrophil elastases during migration. The dys-regulated intracellular signalling of PI-3 kinase, rather than changes in surface receptors, primarily underlies the decreased chemotactic behaviour of neutrophils in aging individuals[17, 86].

In diseases like COPD, neutrophils are pivotal in tissue damage, heightened inflammation, and impaired tissue repair. Recent research indicates that neutrophil functions such as migration, reactive oxygen species (ROS) generation, degranulation, and phagocytosis are impaired in COPD, leading to increased inflammation and reduced bacterial clearance[17, 87].

Impact of malnutrition on respiratory system function during respiratory diseases

Malnutrition significantly affects various organ systems in the body, including the respiratory system, leading to both acute and chronic conditions that often require intensive care unit (ICU) admission, especially among elderly patients. Malnutrition contributes to weakened diaphragmatic muscle strength, reduced ventilatory drive, decreased surfactant production, and an elevated risk of hospital-acquired pneumonia. In COPD patients, protein-energy malnutrition is common due to factors such as decreased appetite, severe shortness of breath, and increased energy expenditure. Early and aggressive nutritional support can notably enhance respiratory and limb muscle strength in these patients[88].

Patients with chronic obstructive pulmonary disease (COPD) are particularly vulnerable to malnutrition, with between 30-60% of inpatients and 10-45% of outpatients at risk. Malnourished COPD patients often experience increased gas trapping, reduced diffusing capacity, and diminished exercise tolerance compared to well-nourished counterparts with similar disease severity. Malnutrition contributes to respiratory muscle wasting in COPD, exacerbating disease progression, or it may occur as a consequence of severe disease itself. Long-term caloric malnutrition can lead to significant weight loss and lung tissue reduction, akin to changes seen in emphysema.

In ICU settings, malnutrition is prevalent among elderly patients admitted with various respiratory diseases like pulmonary embolism, exacerbations of interstitial lung disease, and respiratory failure due to underlying conditions. Although specific prevalence rates vary, malnutrition remains a significant concern among these patients. Timely identification of malnutrition and implementation of appropriate nutritional support are crucial for improving clinical outcomes and reducing illness burden in this vulnerable population[8,89].

Prevalence of malnutrition in elderly with respiratory diseases in ICU

The elderly population worldwide is rapidly increasing. This demographic shift will inevitably lead to a higher number of elderly individuals requiring admission to hospital intensive care units (ICUs) globally. The prevalence of malnutrition among elderly ICU patients with respiratory diseases varies based on factors such as specific respiratory conditions, illness severity, and the characteristics of the patient population under study.

Nevertheless, research consistently shows a high incidence of malnutrition in this patient group, which significantly impacts their clinical outcomes[8, 10, 17, 90].

Elderly patients admitted to ICUs are particularly vulnerable due to various factors that can hinder their ability to eat orally, resulting in compromised nutritional status. Malnutrition is prevalent in hospitals among aging and chronically ill populations, exacerbated by physiological stresses associated with aging. Other risk factors contributing to malnutrition in the elderly include chronic diseases, medication interactions, physical limitations, lifestyle factors, and social issues. Neurological disorders like confusion, dementia, depression, bereavement, and anxiety further contribute to malnutrition rates among hospitalized elderly patients.

Recent research on elderly patients with pneumonia, reported that malnutrition has a significant risk factor for disease severity and poor outcomes. According to a study published in the Journal of the American Geriatrics Society, malnutrition prevalence among hospitalized elderly pneumonia patients ranges from 30% to 50%, correlating with increased illness severity, prolonged hospital stays, and higher mortality rates[17, 91].

Elderly ICU patients experience higher rates of mortality compared to younger patients, with increased severity of illness, higher incidence of ICU-acquired infections, organ failure, and prolonged mechanical ventilation and ICU stays. The NRS 2002 assessment tool indicated that 62.6% of the study population were at risk of malnutrition, with prevalence increasing to 71.24% in older patients compared to 54.7% in those younger than 60 years old. Studies like EuroOOPS have shown that 48%–57% of geriatric patients in Western Europe are at nutritional risk, rising to 87%–100% among intensive care patients, highlighting the association between nutritional risk and poor clinical outcomes.

[A]. Disorders of upper respiratory tract and its impact on nutrition

Dysphagia poses an independent risk for developing aspiration pneumonia. The reported prevalence of dysphagia in older patients hospitalized for pneumonia ranges from 55% to 86%. Pneumonia, a common respiratory infection, often necessitates ICU admission, especially among elderly patients. Given demographic shifts towards an aging population, clinicians must be equipped to manage eating and swallowing difficulties in older adults effectively[92].

S. No.	**Physiological causes**	S. No.	**Pathological causes**	S. No.	**Miscellaneous causes**
1.	Aerophagia & rapid breathing	1.	Fever	1.	Mal-absorption in Cystic Fibrosis
2.	Lack of exercise	2.	Anaemia	2.	Specific Medications
3.	Gastric-hypomotality	3.	Hyper-metabolism in COPD	3.	Poly-pharmacy
4.	Cellular hypoxia	4.	↑ Mechanical work of breathing	4.	Right heart failure
5.	Chronic debility	5.	Tissue hypoxia	5.	↑ Workload of heart
6.	Decreased lung immunity	6.	Inflammation	6.	Pericardial effusion
7.	Decreased lung surfactant	7.	Difficulty in eating with continuous dyspnoea	7.	Vitamin deficiency leading to poor epithelial integrity
8.	Depression, anxiety with anorexia	8.	Anorexia of chronic illness	8.	Atypical mycobacterial infection
9.	Lack of exposure to sun light	9.	Lung cancer & Pneumonia	9.	Amyloidosis
10.	Restricted diet	10.	Poor respiratory muscle strength	10.	Fibrous bronchial strictures post TB

Table no. 4- Various causes of mal-nutrition in patients with respiratory diseases

The ability to eat and swallow safely is fundamental and can provide great pleasure. Dysphagia refers to difficulty swallowing, which can involve problems in the mouth and throat (oro-pharyngeal), voice box (laryngeal), or oesophagus. Presbyphagia describes characteristic changes in swallowing mechanics seen in otherwise healthy older adults. It's crucial for clinicians to distinguish between dysphagia, presbyphagia, and related conditions like globus hystericus to prevent over-diagnosis and unnecessary treatment[17, 93]. Common pathologies in the elderly include post-nasal drip and chronic sinusitis. Gathering a medical history that includes chronic rhinitis, laryngitis, upper respiratory tract tumors, whooping cough, and croup is essential when assessing elderly patients in hospital settings[94]. Changes in voice quality or difficulty swallowing, along with a harsh or painful cough, suggest possible laryngeal abnormalities that warrant further investigation. Paroxysms of coughing often accompanied by stridor indicate upper airway obstruction, potentially requiring rigid or flexible bronchoscopy for detailed assessment.

Untreated upper airway disorders can lead to nutritional deficiencies over time and may contribute to malnutrition if not promptly corrected and managed.

Respiratory infections as the cause of admission to ICU

The lungs rely on both innate and adaptive immune responses to defend against antigens. Innate immunity acts as the initial defence mechanism, while adaptive immunity is antigen-specific and crucial for combating bacteria, viruses, and intracellular pathogens. Adaptive immunity involves immunological memory and antibody production. However, aging brings significant changes to these immune responses, increasing the susceptibility of older adults to respiratory infections that may necessitate ICU admission and contribute to nutritional deficiencies[95].

Introduction to Respiratory Infections in the Elderly

Respiratory infections encompass a broad spectrum of diseases affecting the upper respiratory tract, lungs, and associated structures. In elderly individuals, these infections can range from common colds and influenza to more severe conditions such as pneumonia and acute respiratory distress syndrome (ARDS). The aging process itself brings about physiological changes in the respiratory system, diminishing its ability to effectively combat infections and increasing susceptibility to respiratory illnesses[8, 17, 96].

Pneumonia, in particular, stands out as a leading cause of respiratory-related ICU admissions among the elderly. It is characterized by inflammation and infection of the lung parenchyma, often caused by bacteria, viruses, or fungi. The severity of pneumonia can vary widely, from mild cases managed in outpatient settings to severe forms necessitating intensive care due to respiratory failure[96].

Clinical Impact of Respiratory Infections in ICU

1. **Pathophysiology and Disease Progression**: Respiratory infections in elderly patients can lead to rapid deterioration in respiratory function. The inflammatory response triggered by pathogens can cause alveolar damage, impaired gas exchange, and respiratory distress syndrome, necessitating invasive mechanical ventilation in severe cases.

2. **ICU Admission Criteria**: Elderly patients often present with multiple comorbidities such as chronic obstructive pulmonary disease (COPD), heart

failure, and diabetes, which predispose them to more severe infections requiring ICU care. Admission criteria typically include the need for intensive monitoring, oxygen therapy, and potential respiratory support.

3. **Complications**: Beyond respiratory compromise, infections like pneumonia can lead to systemic complications such as sepsis, multi-organ dysfunction, and prolonged hospital stays. These complications significantly impact overall recovery and prognosis in elderly ICU patients.

Nutritional Impact of Respiratory Infections

1. **Malnutrition Risk**: Elderly patients admitted to the ICU with respiratory infections are at high risk of malnutrition. The metabolic demands associated with infection, coupled with reduced oral intake due to illness severity or interventions like mechanical ventilation, predispose these patients to nutritional deficits.

2. **Impact on Nutritional Status**: Respiratory infections often lead to anorexia, increased metabolic rate, and catabolism, resulting in rapid weight loss and muscle wasting. Malnutrition exacerbates the physiological stress response, impairs immune function, and delays wound healing, further complicating recovery[17, 97].

3. **Nutritional Assessment Challenges**: Assessing nutritional status in critically ill elderly patients can be challenging due to fluid shifts, edema, and altered body composition. Tools such as the Subjective Global Assessment (SGA) and Nutritional Risk Screening (NRS-2002) are commonly used to identify malnutrition and guide nutritional interventions[98].

Strategies for Nutritional Support in Elderly ICU Patients

1. **Early Enteral Nutrition**: Early initiation of enteral feeding is recommended to meet caloric and protein requirements, preserve gut integrity, and enhance immune function. Feeding protocols tailored to ICU patients aim to minimize complications such as aspiration and gastrointestinal intolerance.

2. **Supplemental Nutrition**: In cases where enteral feeding is not feasible, parenteral nutrition may be indicated to provide essential nutrients and prevent further

nutritional deterioration. This approach requires careful monitoring of metabolic parameters and complications.

3. **Multidisciplinary Approach**: Collaboration between nutritionists, dietitians, physicians, and ICU staff is essential to individualize nutritional care plans based on patient-specific needs, underlying conditions, and response to therapy.

Clinical Outcomes and Prognosis

1. **Impact on Recovery**: Adequate nutritional support plays a pivotal role in enhancing recovery outcomes among elderly ICU patients with respiratory infections[9999]. Improved nutritional status correlates with reduced complications, shorter ICU stays, and enhanced functional recovery.

2. **Mortality and Morbidity**: Malnutrition is associated with increased mortality rates and higher incidence of ICU-acquired infections in elderly patients. Addressing nutritional deficiencies early in the course of illness may mitigate these risks and improve overall prognosis.

Challenges and Future Directions

1. **Evidentiary Gaps**: Despite the recognized importance of nutrition in ICU care, evidence gaps persist regarding optimal feeding strategies, timing of initiation, and long-term outcomes in elderly patients with respiratory infections.

2. **Age-Specific Considerations**: Aging-related physiological changes, medication interactions, and cognitive impairments necessitate tailored nutritional interventions that address unique challenges in elderly ICU populations.

3. **Research and Innovation**: Ongoing research into novel nutritional therapies, biomarkers of malnutrition, and strategies to enhance nutritional support in critical care settings is crucial for improving outcomes and quality of life for elderly patients.

Conclusion

In conclusion, respiratory infections leading to ICU admissions pose substantial challenges for elderly patients, impacting respiratory function, overall health outcomes, and nutritional status. Malnutrition in this population exacerbates the complexities of critical illness, requiring timely and targeted nutritional interventions to optimize recovery and reduce mortality[17, 100]. Addressing nutritional needs through early assessment, individualized feeding plans, and interdisciplinary collaboration is essential in mitigating the adverse effects of respiratory infections in elderly ICU patients. Continued research and clinical innovation are pivotal in advancing our understanding and management of nutritional aspects in critical care, ultimately improving outcomes for this vulnerable population [10, 17, 100].

COVID-19 pandemic

Introduction

Malnutrition is a critical health concern, particularly in the elderly population, characterized by inadequate intake or absorption of nutrients needed for optimal health. The COVID-19 pandemic has highlighted the vulnerability of elderly individuals to severe outcomes, including hospitalization, intensive care unit (ICU) admission, and mortality. Understanding how malnutrition influences the occurrence and recovery from COVID-19 in elderly patients is crucial for improving clinical outcomes and guiding public health strategies[10, 17].

Impact of Malnutrition on Immune Function

Malnutrition significantly compromises immune function, impairing both innate and adaptive immune responses. In elderly individuals, nutritional deficiencies can lead to a weakened immune system, making them more susceptible to infections, including viral respiratory illnesses like COVID-19. Nutrients such as vitamins A, C, D, E, zinc, and omega-3 fatty acids play essential roles in immune regulation and response. Deficiencies in these nutrients can impair the body's ability to mount an effective immune defense against viral infections, potentially worsening outcomes in COVID-19.

Malnutrition and COVID-19 Severity

Malnutrition has been implicated in increasing the severity of COVID-19 infection. Studies have shown that malnourished individuals are more likely to experience complications such as acute respiratory distress syndrome (ARDS), pneumonia, and multi-organ failure when infected with respiratory viruses. In elderly COVID-19 patients, pre-existing malnutrition may exacerbate the cytokine storm and inflammatory response triggered by the virus, leading to severe lung damage and systemic complications.

Nutritional Status Assessment in Elderly COVID-19 Patients

Assessing the nutritional status of elderly COVID-19 patients is crucial for determining their risk of complications and guiding appropriate interventions. Tools such as the Mini Nutritional Assessment (MNA) and Subjective Global Assessment (SGA) are commonly used to assess malnutrition risk in clinical settings. These assessments consider factors such as weight loss, dietary intake, and physical signs of malnutrition to stratify patients into categories of nutritional risk.

Impact of COVID-19 on Nutritional Intake

COVID-19 infection can directly impact nutritional intake in elderly patients. Symptoms such as loss of appetite, anosmia (loss of smell), dysphagia, and gastrointestinal disturbances can contribute to reduced food intake and malnutrition. Hospitalized elderly patients, especially those in ICU settings, may require mechanical ventilation or experience prolonged illness, further exacerbating nutritional deficits due to increased energy requirements and metabolic stress.

Role of Nutrition in COVID-19 Recovery

Optimal nutrition plays a critical role in the recovery phase of COVID-19 infection among elderly patients. Adequate protein intake is essential for maintaining muscle mass and strength, which are crucial for respiratory function and overall physical recovery. Micronutrients such as vitamin D, zinc, and antioxidants support immune function and may help reduce the severity and duration of COVID-19 symptoms.

Clinical Management and Nutritional Support

Early identification of malnutrition and implementation of nutritional support strategies are essential components of clinical management for elderly COVID-19 patients. Nutritional interventions may include oral nutritional supplements, enteral feeding via nasogastric or percutaneous routes, and, in severe cases, parenteral nutrition. The goal is to meet energy and protein requirements, prevent further deterioration of nutritional status, and support immune function during recovery.

Challenges in Nutritional Management

Several challenges exist in managing the nutritional needs of elderly COVID-19 patients. These include difficulties in assessing nutritional status accurately in acutely ill patients, managing feeding intolerance, and coordinating multidisciplinary care in ICU settings. Additionally, elderly patients may have comorbidities and medications that affect nutrient absorption and metabolism, requiring individualized nutrition care plans [17, 101].

Research Evidence and Clinical Trials

Research on the impact of nutrition on COVID-19 outcomes is on-going, with several clinical trials investigating the role of specific nutrients and dietary interventions. Preliminary evidence suggests that adequate vitamin D levels may reduce the risk of severe COVID-19 outcomes, while high-protein diets and supplementation with omega-3 fatty acids may improve clinical recovery. Longitudinal studies are needed to elucidate the optimal nutritional strategies for elderly patients with COVID-19.

Public Health Implications and Recommendations

Addressing malnutrition in elderly populations, both during and beyond the COVID-19 pandemic, is critical for improving health outcomes and reducing healthcare costs. Public health strategies should focus on promoting healthy eating habits, screening for malnutrition in high-risk populations, and integrating nutritional care into comprehensive healthcare systems. Education of healthcare providers and caregivers on the importance of nutrition in elderly patients is essential for optimizing clinical outcomes.

Conclusion

In conclusion, malnutrition significantly impacts the occurrence and recovery from COVID-19 infection in elderly patients. Nutritional deficiencies compromise immune function, increase susceptibility to severe complications, and hinder recovery efforts. Early identification of malnutrition and implementation of targeted nutritional interventions are essential for improving outcomes in elderly COVID-19 patients. Continued research and clinical trials are needed to further elucidate the role of nutrition in mitigating the impact of COVID-19 and enhancing resilience in vulnerable populations.

Tuberculosis (TB) infection in elderly patients

Understanding the impact of malnutrition on the occurrence and recovery from Tuberculosis (TB) infection in elderly patients, especially those admitted to intensive care units (ICUs), involves exploring the complex interplay between nutritional status, immune function, disease severity, and clinical outcomes. TB remains a significant global health challenge, exacerbated by factors such as malnutrition, which disproportionately affect vulnerable populations like the elderly[8, 17, 101].

Introduction to Tuberculosis and Malnutrition

Tuberculosis, caused by Mycobacterium tuberculosis, primarily affects the lungs but can also involve other organs. Malnutrition, characterized by inadequate intake or absorption of essential nutrients, weakens the immune system, making individuals more susceptible to infections like TB. In elderly patients, malnutrition is prevalent due to age-related physiological changes, chronic diseases, and socioeconomic factors, contributing to poorer health outcomes when TB infection occurs.

Impact of Malnutrition on Immune Response in TB

Malnutrition compromises both innate and adaptive immune responses crucial for combating TB. Essential nutrients such as vitamins A, C, D, E, zinc, and iron play key roles in immune function. Deficiencies in these nutrients impair macrophage activation, T-cell function, and cytokine production, which are critical for controlling TB infection and preventing disease progression. Elderly patients with TB and malnutrition often

exhibit delayed and inadequate immune responses, leading to prolonged infectious periods and increased severity of TB symptoms.

Clinical Manifestations of TB in Malnourished Elderly Patients

Malnutrition exacerbates the clinical manifestations of TB in elderly patients. Common symptoms include chronic cough, haemoptysis, fever, night sweats, and weight loss, which are further compounded by nutritional deficiencies. Malnourished elderly individuals with TB may experience more severe respiratory symptoms, higher rates of complications such as pleural effusion or disseminated disease, and increased mortality compared to well-nourished counterparts[102].

Nutritional Assessment and Management in TB Patients

Assessing and managing nutritional status is essential in elderly TB patients, particularly those admitted to ICUs. Tools like the Mini Nutritional Assessment (MNA) or Subjective Global Assessment (SGA) help identify malnutrition risk and guide nutritional interventions. ICU admission may necessitate enteral or parenteral nutrition support to meet energy and protein requirements, especially in critically ill patients unable to consume adequate oral nutrition due to disease severity or treatment side effects.

Impact of Malnutrition on TB Treatment Outcomes

Malnutrition significantly impacts TB treatment outcomes in elderly patients. Adequate nutrition supports antimicrobial therapy efficacy, reduces treatment-related complications, and enhances recovery. Conversely, malnutrition delays treatment response, increases the risk of drug toxicity, and predisposes patients to treatment failure, relapse, or multidrug-resistant TB. Optimizing nutritional status through timely interventions improves adherence to treatment regimens and reduces the overall burden of disease.

Challenges in Nutritional Management of Elderly TB Patients in ICU

Managing nutritional needs in elderly TB patients admitted to ICUs presents several challenges. These include difficulties in nutritional assessment in critically ill patients, complications such as gastrointestinal intolerance or feeding tube-related issues, and interactions between TB medications and nutrient absorption. Multidisciplinary collaboration among healthcare professionals, including dietitians, infectious disease

specialists, and critical care teams, is essential for individualizing nutrition care plans and optimizing patient outcomes.

Research Evidence and Clinical Strategies

Research on the impact of nutrition on TB outcomes in elderly patients remains limited but highlights the critical role of micronutrients, protein supplementation, and overall dietary adequacy in improving clinical outcomes. Clinical trials and observational studies underscore the benefits of early nutritional support in reducing morbidity and mortality among malnourished TB patients, although more robust evidence is needed to establish optimal nutrition strategies tailored to elderly populations.

Public Health Implications and Recommendations

Addressing malnutrition in elderly TB patients admitted to ICUs is paramount for enhancing treatment effectiveness and reducing healthcare costs. Public health strategies should prioritize nutritional screening, early intervention, and education on dietary management in TB care programs. Promoting access to nutrient-rich foods, micronutrient supplementation, and nutritional counselling can mitigate the impact of malnutrition on TB outcomes and improve long-term health outcomes in elderly populations[103].

Conclusion

In conclusion, malnutrition significantly influences the occurrence and recovery from TB infection in elderly patients admitted to ICUs. Nutritional deficiencies compromise immune function, exacerbate TB symptoms, and hinder treatment outcomes. Early identification of malnutrition and implementation of targeted nutritional interventions are critical for optimizing clinical outcomes and reducing the global burden of TB, particularly in vulnerable populations like the elderly. Continued research and evidence-based practices are essential for developing effective nutritional strategies that support comprehensive TB management and improve health outcomes in elderly patients.

Impact of malnutrition on the occurrence and recovery of Pneumonia in elderly Patients

Pneumonia remains a significant cause of morbidity and mortality worldwide, particularly among elderly patients admitted to intensive care units (ICUs). Malnutrition, a common and often overlooked issue in this demographic, plays a crucial role in both the

occurrence and recovery from pneumonia. This essay explores the multifaceted impact of malnutrition on elderly patients with pneumonia, focusing on its influence on susceptibility, severity, complications, and recovery outcomes.

Introduction

Pneumonia is an acute infection of the lungs that can range from mild to severe and is characterized by inflammation of the lung parenchyma. In elderly patients, pneumonia is frequently associated with complex medical conditions, compromised immune responses, and physiological changes that predispose them to severe outcomes, including ICU admission[8, 17, 104].

Malnutrition, defined as an imbalance between nutrient intake and requirements, is prevalent among elderly individuals due to various factors such as reduced appetite, altered taste perception, chewing and swallowing difficulties, chronic diseases, and socio-economic factors. Malnutrition not only predisposes elderly patients to infections like pneumonia but also complicates their recovery process, prolonging hospital stays and increasing mortality rates.

Impact of Malnutrition on Occurrence of Pneumonia

Immune Function and Susceptibility

Adequate nutrition is essential for maintaining immune function, which is critical in defence against infections like pneumonia. Malnutrition compromises both innate and adaptive immune responses. The innate immune system, the body's first line of defence, includes mechanisms like neutrophils, macrophages, and natural killer cells, all of which are influenced by nutrient deficiencies. Malnutrition reduces the production and function of these immune cells, impairing the ability to recognize and eliminate pathogens effectively[17, 105].

Furthermore, malnutrition diminishes the production of antibodies and cytokines, essential components of adaptive immunity. Elderly patients with malnutrition have reduced immunoglobulin levels, impaired lymphocyte function, and altered cytokine production, which collectively weaken their ability to mount an effective immune response against pathogens like *Streptococcus pneumoniae*, the most common bacterial cause of pneumonia in this age group[106].

Respiratory Muscle Strength and Function

Respiratory muscle strength is crucial for maintaining adequate ventilation and oxygenation, especially in pneumonia where respiratory compromise can lead to respiratory failure. Malnutrition leads to muscle wasting and weakness, including the diaphragm and intercostal muscles involved in breathing. This weakness predisposes elderly patients to respiratory failure during pneumonia and complicates weaning from mechanical ventilation in ICU settings.

Impact of malnutrition on severity and complications of Pneumonia

Prolonged Hospital Stay and Increased Mortality

Malnutrition exacerbates the severity of pneumonia and its associated complications, leading to prolonged hospital stays and increased mortality rates in elderly ICU patients. Studies have consistently shown that malnourished patients with pneumonia experience worse clinical outcomes compared to well-nourished counterparts[107]. They have higher rates of ICU admissions, longer durations of mechanical ventilation, increased incidence of sepsis, and higher mortality rates, highlighting the critical role of nutrition in pneumonia management.

Impaired Wound Healing and Respiratory Complications

Malnutrition impairs tissue repair and wound healing, which are essential for resolving lung inflammation and preventing complications such as lung abscesses and empyema. Delayed wound healing increases the risk of secondary infections and prolongs recovery times in elderly patients with pneumonia.

Nutritional management and interventions in elderly ICU patients with Pneumonia

Screening and Assessment

Early identification of malnutrition is paramount in elderly patients admitted to the ICU with pneumonia. Screening tools such as the Subjective Global Assessment (SGA) and the Malnutrition Universal Screening Tool (MUST) help identify patients at risk. Nutritional assessment should include evaluating weight loss, dietary intake, and physical signs of malnutrition such as muscle wasting and fat loss.

Nutritional Support

Nutritional support plays a crucial role in the management of malnutrition in elderly ICU patients with pneumonia. Enteral nutrition, delivered via feeding tubes, is preferred if oral intake is inadequate but feasible. Parenteral nutrition may be considered for patients unable to tolerate enteral feeding or with contraindications to gastrointestinal feeding. Protein intake should be optimized to support immune function and muscle strength, while adequate caloric intake is essential for energy expenditure and tissue repair[10, 108].

Multidisciplinary Approach

A multidisciplinary approach involving dieticians, physicians, nurses, and pharmacists is essential for implementing and monitoring nutritional interventions. Individualized nutrition plans should consider underlying medical conditions, medication interactions, and patient preferences to optimize outcomes.

Risk factors: -There are a number of risk-factors responsible for CAP. These include extremes of age, comorbid diseases, such as diabetes, chronic obstructive pulmonary disease (COPD), cardiovascular disease and HIV infection. Excessive alcohol consumption, tobacco smoking, malnutrition, obesity and immunosuppressive treatments are also important risk factors.

Diagnosis and severity assessment: - One aspect of patient prognosis that requires special consideration is the presence of cardiac changes and complications, such as cardiac failure, cardiac arrhythmias, and even myocardial infarction, as a complication of the pneumonia, even in patients with no previous underlying cardiac condition. These events tend to occur quite early in the course of the infection and are associated with an increased short-term mortality. Their occurrence in patients with CAP also highlights the potential benefit of CAP prevention using pneumococcal and influenza vaccination. The **CURB-65** score stands for confusion (mental), blood urea (>19mg/dL), respiratory rate (>30 breaths/min), blood pressure (systolic <90 mm Hg) and age of 65 years and more. CURB-65 is used to diagnose patients with severe CAP at high risk of mortality while Pneumonia severity index (PSI) identifies low-risk patients who can be managed at home. CRB-65 (without the need for blood urea) is the modified version of CURB-65 with equal results[8, 10, 17, 108].

Pneumonia severity	Moderate severity	High severity
BTS guidelines	1. CURB65 score 2 Treat with oral/*i.v.* amoxicillin +clarithromycin or doxycycline, moxifloxacin or levofloxacin	1. CURB65 score 3–5 Treat with co-amoxiclav plus clarithromycin/ benzylpenicillin plus levofloxacin or ciprofloxacin/cephalosporine plus clarithromycin
ATS/IDSA guidelines	1. Direct admission to intensive care unit: septic shock requiring vasopressor support and/or respiratory failure requiring intubation and ventilation β-lactam plus a macrolide or fluoroquinolone	

BTS: British Thoracic Society; ATS: American Thoracic Society; IDSA: Infectious Disease Society of America; CURB65: confusion, urea >7 mmol·L^{-1}, respiratory rate ⩾30 breaths·min^{-1}, blood pressure <90mmHg (systolic) ⩽60 mmHg (diastolic), age ⩾65 years.

Table no. - CURB-65 based Pneumonia severity assessment & management

Treatment: - Once the diagnosis of Pneumonia has been established, appropriate empiric antibiotic therapy should be promptly initiated while awaiting drug susceptibility testing results. The treatment should be patient specific and decided after considering risk factors, comorbidities (Diabetes, Renal, Hepatic, Cardiac, and Neurological disorders), local microbiological epidemiology and maximally and minimally toxic antibiotics should be used. Common prescribing errors include irrational combination therapy, frequent change of anti-biotics, suboptimal dose and ignorance of pharmacokinetic and pharmacodynamics factors like drug interactions and tissue penetration in all elderly patients[8, 10, 17, 109].

Case Type	Choice of Antibiotic agent
Out-patient- without comorbidities	Macrolides or Beta-lactam antibiotics
Out-patient with comorbidities	Macrolides plus Beta-lactam antibiotics
Hospitalized- Non-ICU	Macrolides plus Beta-lactam antibiotics/Fluoroquinolone
Hospitalized in ICU	Macrolides or Beta-lactam or Fluoroquinolone plus Aminoglycoside antibiotics

Table no. 7 - Choice of antibiotics in the treatment of Pneumonia

Adjunctive Therapy: - General support for patients with CAP includes attention to nutrition and hydration, analgesia and supplemental oxygen. Macrolide antibiotics and corticosteroids are important adjunctive therapies which have been frequently used. Addition of a macrolide to the antibiotic therapy adds to the anti-inflammatory and immune-modulatory actions. These actions help augment host responses as well as attenuate the virulence of bacteria. Corticosteroid use is most commonly recommended in patients with severe CAP in association with septic shock.

Prevention of Infection:-Vaccination An important aspect to consider in the overall control of CAP, and in particular *pneumococcal* pneumonia. Currently two *pneumococcal* vaccines are commercially available, namely the polyvalent polysaccharide vaccine (PPV), used predominantly in adults and the pneumococcal conjugate vaccine (PCV), used predominantly in children. Evidence points to a lower, but not insignificant protective effect, even in non-bacteremic pneumonia, such that this should not preclude the more widespread use of the vaccine. Furthermore, recent studies also point to a significant beneficial effect in preventing *pneumococcal* pneumonia and decreasing disease severity, even in the vaccinated elderly. Lower rate of pneumonia and improved outcome have also been seen in HIV-infected adults who have received PPV previously.

Nosocomial pneumonia:-

Nosocomial pneumonia is a significant problem worldwide. It is responsible for an increased mortality, morbidity, hospital stay and healthcare costs. Hospital-acquired pneumonia (HAP) is the second most common form of nosocomial infection. There is 6–20-fold increased risk of acquiring hospital acquired pneumonia (HAP)/ventilator-associated pneumonia (VAP) in the mechanically ventilated patients.

Hospital-acquired pneumonia:-

Hospital-acquired pneumonia (HAP) is pneumonia occurring 48 hours after admission which is neither present nor incubating at the time of admission. Ventilator-associated pneumonia (VAP) is pneumonia occurring 48–72 hours after endotracheal intubation or tracheostomy[17, 110].

Healthcare-associated pneumonia (HCAP): -

It is defined as pneumonia occurring in patients in the non-hospital settings but who have got extensive healthcare contact; it excludes HAP, VAP and CAP. HCAP is associated with the following risk factors:

• Hospitalization for more than two days in preceding 90 days.

• Residence in a nursing home or extended care facility

• Home infusion therapy

• Patients receiving chronic dialysis or home wound care.

There is a lot of controversy surrounding the definition of HCAP. It is not as well standardized as HAP or VAP.

Pathogenesis: - Nosocomial pneumonia develops when microorganisms reach the lung and overcome the lung host defences. The main mechanism involved in the pathogenesis of nosocomial pneumonia is the colonization of oropharynx with pathogenic microorganisms and subsequent micro-aspiration of these contents. Predominant exogenous sources include breach of normal mucosal integrity (with numerous devices—nasogastric tube, endotracheal tube), contact through healthcare personnel, colonization of endotracheal tube biofilm. Endogenous factors that lead to increase in the gastric pH like acute illness; drugs (like proton pump inhibitors) can disrupt the sterility of the stomach and upper gastrointestinal tract, and lead to gastrointestinal colonization.

Conclusion

In conclusion, malnutrition significantly impacts the occurrence, severity, and recovery from pneumonia in elderly patients admitted to the ICU. Elderly individuals are particularly vulnerable to malnutrition due to age-related physiological changes, chronic diseases, and reduced functional capacity[17, 110]. Addressing malnutrition through early nutritional interventions is crucial for improving outcomes, reducing complications, and enhancing recovery in elderly ICU patients with pneumonia. Future research should focus on optimizing nutritional strategies and exploring novel interventions to mitigate the impact of malnutrition on pneumonia outcomes in this vulnerable population.

Impact of malnutrition on the Occurrence and Recovery in Fungal Lung Infection

Fungal lung infections represent a significant burden in clinical settings, especially among elderly patients admitted to intensive care units (ICUs). Malnutrition, a common condition in the elderly population, plays a critical role in both predisposing individuals to fungal infections and complicating their recovery. This essay explores the multifaceted impact of malnutrition on elderly patients with fungal lung infections, focusing on its influence on susceptibility, severity, complications, and recovery outcomes[17].

Introduction

Fungal lung infections, such as invasive aspergillosis, candidiasis, and cryptococcosis, are increasingly recognized as important causes of morbidity and mortality, particularly in immune-compromised patients. Elderly individuals often experience age-related declines in immune function, chronic diseases, and physiological changes that predispose them to fungal infections. Malnutrition exacerbates these vulnerabilities, compromising immune responses and increasing the risk of severe fungal lung infections that require ICU admission[8, 10, 17].

Impact of Malnutrition on Susceptibility to Fungal Lung Infections

Immune Function and Host Defence

Adequate nutrition is crucial for maintaining immune function, which is essential for defence against fungal pathogens. Malnutrition, characterized by deficiencies in macro- and micronutrients, compromises both innate and adaptive immune responses. In elderly patients, malnutrition leads to reduced phagocytic activity of neutrophils and macrophages, impaired lymphocyte function, and altered cytokine production, all of which are critical in combating fungal infections.

Fungal pathogens such as Candida species and Aspergillus spp. exploit host vulnerabilities, including malnutrition-induced immune dysfunction, to establish infections in the respiratory tract. Reduced nutritional intake and poor overall nutritional status further weaken immune defences, making elderly patients more susceptible to fungal colonization and invasive infections.

Impact of Malnutrition on Severity and Complications of Fungal Lung Infections

Disease Progression and Clinical Outcomes

Malnutrition significantly worsens the severity and clinical course of fungal lung infections in elderly ICU patients. Studies indicate that malnourished individuals experience more severe forms of fungal diseases, higher rates of treatment failure, prolonged hospital stays, and increased mortality rates compared to well-nourished counterparts.

Invasive fungal infections, such as invasive aspergillosis, can lead to complications such as fungal pneumonia, lung abscesses, and dissemination to other organs in malnourished elderly patients. These complications not only complicate treatment but also increase the risk of secondary infections, multi-organ failure, and mortality, highlighting the critical role of nutrition in managing fungal lung infections.

Classical risk groups:	**Newly recognized risk groups:**
• Patients on cytotoxic chemotherapy for malignant diseases • Patients with hematopoietic stem cell transplantation • Severe AIDS (CD4 cell count <100) • Immunosuppressive therapy in autoimmune diseases • Other transplantations • Aging population	• Stay in intensive care units • Chronic obstructive lung disease • Administration of prolonged low dose of steroids • Cirrhosis of liver • Iron overload • Diabetes especially when poorly controlled • Sepsis with immune-prophylaxis • Malnutrition • Moderate-to-severe liver or kidney failure

Table no. 8 - Susceptible population for fungal respiratory tract infections.

Impact on Respiratory Function and Recovery

Malnutrition exacerbates respiratory compromise in elderly patients with fungal lung infections. Respiratory muscle weakness and reduced lung function, common consequences of malnutrition, contribute to respiratory failure and the need for mechanical ventilation in ICU settings. Delayed recovery from fungal infections due to malnutrition-related immune suppression and impaired tissue repair further prolongs ICU stays and increases healthcare costs.

Multidisciplinary approach to fungal lung infection

A multidisciplinary approach involving dieticians, physicians, infectious disease specialists, and critical care nurses is essential for implementing and monitoring nutritional interventions. Individualized nutrition plans should consider underlying medical conditions, medication interactions, and patient preferences to optimize outcomes and reduce the risk of complications associated with fungal lung infections in elderly ICU patients. Optimizing nutritional support is crucial for improving outcomes in malnourished elderly patients with fungal lung infections. Enteral nutrition is preferred if oral intake is feasible but inadequate, whereas parenteral nutrition may be necessary for patients unable to tolerate enteral feeding or with gastrointestinal complications. Protein supplementation is particularly important for enhancing immune function and supporting respiratory muscle strength, while adequate caloric intake promotes healing and recovery.

Conclusion

Malnutrition significantly impacts the occurrence, severity, and recovery from fungal lung infections in elderly patients admitted to the ICU. Elderly individuals are particularly vulnerable due to age-related immune dysfunction, chronic diseases, and nutritional deficiencies that predispose them to severe fungal infections. Addressing malnutrition through early nutritional interventions is critical for improving clinical outcomes, reducing complications, and enhancing recovery in elderly ICU patients with fungal lung infections[17].

Lung abscess

A lung abscess occurs when pus accumulates in a decayed cavity within the lung tissue. This cavity is typically surrounded by a wall made of fibrous tissue. Necrotizing

pneumonia or lung gangrene refers to the presence of either a large abscess (greater than 2 cm) or multiple smaller abscesses. Abscesses lasting less than 6 weeks are classified as acute, while those persisting for more than 6 weeks are termed chronic.

In healthy individuals, the primary cause of abscess formation is often aspiration or pneumonia. Conversely, secondary abscesses develop in individuals with pre-existing lung conditions like bronchial obstruction or bronchiectasis. Secondary abscesses are more common in immune-compromised individuals and can also originate from infections spreading from other parts of the body[10, 17, 111].

Etiology: - The most common cause of lung abscess is the aspiration of anaerobic bacteria from the mouth and throat, often associated with gum disease. Other bacteria commonly involved include aerobic gram-positive and gram-negative organisms. *Staphylococcus aureus, Klebsiella pneumoniae, E. coli, and Streptococcus pneumoniae* are frequently found in cases of lung abscess. Complications from pneumococcal pneumonia, especially leading to lung abscess formation, are rare but significant.

In immune-compromised individuals, lung abscesses can also be caused by non-bacterial and atypical bacterial pathogens such as Mycobacterium species, parasites, or fungi. Parasitic abscesses from Paragonimus and Entamoeba species, as well as fungal abscesses from *Aspergillus, Cryptococcus, Histoplasma, Blastomyces*, among others, are uncommon but may occur, particularly in patients with HIV infection, cancer, or who have undergone organ transplantation.

These microorganisms reach the lower respiratory tract through various factors, including local or general conditions. Infections can also spread to the lungs from other sources such as infected areas in the chest wall, abscesses below the diaphragm, or through the bloodstream.

Pathogenesis: - The primary cause of lung abscess formation is often the aspiration of oro-pharyngeal and gastro-oesophageal contents. This occurs frequently in individuals with poor oral hygiene and oro-gingival infections. Aspiration can also occur during episodes of vomiting, which may be due to conditions causing difficulty swallowing. Additionally, states of altered consciousness such as seizures, acute alcohol intoxication, general anaesthesia, head injury, stroke, and poisoning can predispose individuals to aspiration.

When aspirated contents reach the lungs, they create a focal point for infection, leading to tissue necrosis and the formation of an abscess.

Airway disorders in elderly population

Chronic obstructive pulmonary diseases when coupled with another acute disease process, results in further nutritional deterioration. Patients suffering from chronic obstructive pulmonary diseases (COPD) are at increased risk of under nutrition due to factors such as reduced appetite, profound dyspnoea and increased energy expenditure. A systemic review and meta-analysis published in the Journal of Parenteral and Enteral Nutrition found that malnutrition prevalence rates in COPD patients admitted to the ICU ranges from 20%-50%. A systemic review conducted recently highlighted factors such as decreased dietary intake, muscle wasting, and systemic inflammation contributing to malnutrition in this population.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD), characterized by progressive airflow limitation, is now considered a systemic disease with widespread extra-pulmonary manifestations. While some comorbidity is caused by COPD itself, the others result because of the common risk factors such as tobacco smoking or due to chronic systemic inflammation possibly as a spill-over of the inflammation in the airways and lung parenchyma.

COPD is a significant global contributor to illness and death. Its occurrence and impact vary widely among countries and regions, influenced mainly by factors such as smoking, exposure to indoor air pollution, occupational hazards like particulate matter, and low socioeconomic status. It's crucial for the world to recognize the looming epidemic of COPD and implement effective measures to reduce this growing burden.

Risk factors for COPD: - There are numerous risk factors critical to the onset of COPD. Some of these factors are notably more prevalent among individuals of lower socioeconomic status. These include inadequate nutrition, crowded living conditions, and respiratory infections during childhood. There is a higher likelihood of exposure to tobacco smoke, biomass smoke, other air pollutants, and occupational hazards. Importantly, poor socioeconomic status is independently linked to COPD. Environmental factors like tobacco smoking and air pollution are frequently identifiable contributors.

While genetic predisposition may also play a significant role, it currently remains an area requiring further investigation.

Epidemiology: -The World Health Organization (WHO) estimates that COPD causes approximately 3 million deaths worldwide, accounting for nearly 5% of all global deaths. According to the Global Burden of Disease Study (GBDS) 2010 report, although the number of COPD-related deaths has decreased from 3.1 million to 2.9 million over the past two decades, COPD remains the third leading cause of mortality. It now ranks as the third most common cause of death globally, with nearly 90% of deaths occurring in low- and middle-income countries. India and China alone account for 63% of COPD-related deaths. In 2002, India reported over half a million deaths due to COPD, second only to China with an estimated 1.3 million deaths. Projections indicated a mortality rate increase of over 30% every decade. However, while China's COPD-related deaths declined to 0.93 million by 2010 from the peak of 1.3 million, India surpassed the projected 30% increase, with COPD mortality rising from 0.59 million in 2002 to 0.91 million in 2010. This increase has positioned India as the primary contributor to the heightened global burden of COPD[8, 10, 17].

Prevalence of COPD in India: - An extensive review of all data published on COPD prevalence in India from 1964 to 1995 has provided the backbone for the estimation of morbidity and mortality and projected economic burden of COPD. This review showed that there is a wide variation in the prevalence of COPD in different parts of India, the highest being reported from North Indian rural population (9.4%). This wide variation was explained by the wide variety in the exposure to risk factors like smoking, environmental tobacco smoke, biomass fuel, occupation and socioeconomic status. Another review assimilated data from 16 studies on chronic bronchitis and COPD conducted after 1980 and presented the prevalence of COPD in different geographical, socioeconomic conditions in racially and culturally different populations in India, which are exposed to different risk factors like tobacco smoke, indoor air pollution due to use of biomass fuel and outdoor air pollution. Despite the heterogeneity of these studies in their study population, methodology, study tools used, risk factors assessed and outcomes, the study concludes that the existing estimates of general prevalence of chronic bronchitis in rural areas was between 6.5% to 7.7%. Indian Study on Epidemiology of Asthma, Respiratory symptoms and chronic bronchitis (INSEARCH)[17], the large multi-centric field survey that was conducted with the help of a structured and validated questionnaire

in both the urban as well as rural populations at 16 different centres across India revealed overall prevalence of about 4%. Prevalence of COPD in smokers was 2.65 times higher than in non-smokers, and amongst the smokers, the prevalence was higher amongst bidi smokers as compared to cigarette smokers. Exposure to Environmental Tobacco Smoke (ETS) was associated with a 40% increased odds of COPD which increased to 57% amongst those concomitantly exposed to biomass fuel. A questionnaire-based study amongst 12,000 slum dwellers from Pune city in Maharashtra is also notable for the fact that probably for the first time, this study showed that amongst those diagnosed with COPD, 69% were never smokers[17, 111]. The overall prevalence of questionnaire-diagnosed COPD amongst the never smoker males was 6.8% and females was 4.4%. The National Commission on Macroeconomics and Health in its Background Papers on the Burden of Diseases estimated that out of the 65 million cases of chronic respiratory diseases in India in 2005, about 17 million were due to COPD. The morbidity due to COPD was projected to increase to 22.2 million by the year 2016. The current prevalence rate of about 7% to the population in India which is above 45-years, the estimated number of COPD patients in India would be about 25 million already.

Malnutrition and COPD: - Malnutrition can significantly impact the course and exacerbation of COPD in elderly patients, exacerbating their health challenges in several key ways.

Nutritional deficiencies and respiratory muscle weakness: Malnutrition often leads to deficiencies in essential nutrients such as protein, vitamins (especially vitamin D and C), and minerals (such as magnesium and zinc). These deficiencies can contribute to muscle weakness, including the respiratory muscles involved in breathing. Weak respiratory muscles make it harder for COPD patients to effectively clear their airways and can lead to increased respiratory effort during exacerbations.

Impaired Immune Function: Malnutrition compromises the immune system, reducing its ability to fight infections. COPD patients are already susceptible to respiratory infections, which are common triggers for exacerbations. Malnourished elderly COPD patients may experience more frequent and severe infections, leading to more frequent exacerbations and hospitalizations.

Reduced Respiratory Reserve: COPD patients have limited respiratory reserve, meaning they have less capacity to cope with stressors such as infections or

exacerbations. Malnutrition further reduces this reserve by weakening respiratory muscles and overall physical strength, making it harder for elderly patients to recover from exacerbations.

Delayed Wound Healing: Malnutrition can impair wound healing, which is particularly problematic for COPD patients who may have wounds from surgical procedures or pressure ulcers due to prolonged bed rest during exacerbations. Delayed wound healing increases the risk of infections and can prolong hospital stays.

Increased Risk of Cardiovascular Complications: Malnutrition is associated with cardiovascular complications such as heart failure and arrhythmias, which can worsen the prognosis in COPD patients during exacerbations. Cardiovascular diseases are common comorbidities in elderly COPD patients, and malnutrition exacerbates these risks.

Impact on Quality of Life: Malnutrition contributes to overall frailty and decreases quality of life in elderly COPD patients. Poor nutrition can lead to fatigue, depression, and reduced physical activity, further exacerbating the cycle of muscle weakness and respiratory compromise.

Muscle wasting and weight loss: - Muscle wasting and weight loss are common in COPD patients, often due to increased basal metabolic rate and the added strain of breathing. Factors contributing to elevated metabolic rate include inhaled beta-2 agonists, altered amino acid composition, and tissue hypoxia. Muscle protein breakdown, particularly noticeable in muscles like the quadriceps, intensifies during acute COPD exacerbations, spurred by acidosis, infections, metabolic changes, or insufficient caloric intake. Skeletal muscle mass, notably in the lower limbs, diminishes significantly. Weakened quadriceps in advanced cases stems largely from reduced physical activity. Overall, weight loss and muscle wasting reflect an imbalance between protein degradation and replacement, influenced by shifts in endocrine hormones such as insulin, growth hormone, testosterone, and glucocorticoids[10,17].

Management Challenges: Malnutrition complicates the management of COPD exacerbations. It may require additional nutritional support such as dietary counselling, oral nutritional supplements, or in severe cases, enteral or parenteral nutrition. However, implementing these interventions can be challenging in elderly patients with multiple comorbidities and complex medical needs.

COPD in Occupational exposures: - Occupational exposures are known to cause COPD for a long time. Exposures to toxic gases at workplace, grain dust in agriculture farms, and dust and fumes in factories were reported to be strongly associated with COPD in several earlier studies. Longitudinal studies have also documented the association of COPD with other occupational exposures amongst miners working in coal and hard rock mining as well as workers engaged in tunnel construction and concrete manufacturing. The effect of heavy exposure to dusts is detrimental even more than cigarette smoking. Risk of death due to COPD is significantly higher among construction workers and those engaged in brick manufacturing, gold mining as well as iron and steel foundries. There is prolonged exposure to silica dust in ship building occupations where average respirable dust levels reach up to 10,000 mcg/ m3.

Therapeutic considerations: - The recognition of systemic features has made the greatest impact on clinical course, complications, and therapy of COPD. The variable host response and subsequent clinical phenol-typing have made it possible to develop a targeted treatment with the help of a multisystem approach. COPD treatment is no longer limited to inhalational and oral bronchodilators and ICS alone, but a multimodality treatment for multiple comorbidities. Some of the treatment failures are possibly due to the phenotype heterogeneity of COPD and its different systemic manifestations. The future treatments with statins, angiotensin-converting enzyme inhibitors, and anti-inflammatory drugs, and targeting the comorbid conditions may help to change the natural history of COPD and improve the mortality. Lastly, it is shown that the elderly patients, who are at an increased risk of almost all the comorbidities of COPD discussed earlier, may benefit from the treatment of concomitant comorbidities. Further, development of anti-aging molecules, such as sirtuin agonists, can be helpful and may also reduce the risk of lung cancer. It should, however, not be overlooked that aging alone is not an exclusion criterion for pulmonary rehabilitation and other treatment of COPD. Assessment and appropriate treatments of COPD and the comorbid conditions has been shown to provide similar benefits of management[112].

Supplementary oxygen in COPD

Supplementary oxygen in COPD is crucial for correcting hypoxemia and is a key part of treatment. It's essential during acute exacerbations in hospitalized patients. Controlled oxygen (24%) is preferred to prevent excessive retention of CO_2. Long-term oxygen

therapy (LTOT), also known as domiciliary oxygen, is recommended for specific patients. Before prescribing LTOT, careful evaluation is necessary to avoid worsening respiratory failure due to CO_2 build-up in patients with CO_2 retention[17, 112].

LTOT has been shown to offer several benefits:

1. Increased endurance and exercise capacity
2. Reduced breathlessness
3. Lowered pulmonary hypertension by lessening hypoxic pulmonary vasoconstriction
4. Decreased haematocrit levels by reducing erythropoietin production
5. Improved quality of life and cognitive function
6. Less severe drops in oxygen levels during sleep.

Domiciliary oxygen therapy can be administered in three ways:

1. Long-term, low-dose oxygen for chronic respiratory failure
2. Portable oxygen therapy for exercise-induced hypoxia and breathlessness
3. Short-term oxygen therapy for temporary symptom relief.

Patient selection for LTOT should involve assessment by a pulmonary specialist. Absolute indications include stable COPD with hypoxemia and oedema, FEV1 less than 1.5 L, and forced vital capacity (FVC) less than 6 kPa, demonstrated stability over 3 weeks on optimal therapy.

Relative indications for LTOT include similar criteria without oedema or $PaCO_2$ levels exceeding 45 mm Hg. Portable oxygen is recommended for palliative care to relieve symptoms, especially for patients who de-saturate during exercise. Its effectiveness can be assessed during a treadmill or 6-minute walk test with the patient using the portable oxygen cylinder. Portable oxygen may also be necessary for patients with severe exercise limitations or during commercial airline flights, provided by the airline.

In summary, malnutrition in elderly patients with COPD exacerbates their vulnerability to acute exacerbations by weakening respiratory muscles, impairing immune function, reducing respiratory reserve, delay in wound healing, increasing cardiovascular risks, and diminishing quality of life. Addressing nutritional deficiencies and providing appropriate nutritional support are crucial components of comprehensive management to improve outcomes and reduce the frequency and severity of exacerbations in this vulnerable population.

Bronchial Asthma

Asthma, although known since antiquity, remains a disease of unclear etiology, wide heterogeneity, and marked variability. There is no uniform agreement on its definition in spite of the fact that the problem is recognized and appreciated by even the layman, all over the world. For a clinician, it is characterized by episodic wheezing, breathlessness and/or cough. Functionally, there is widespread narrowing of the intrapulmonary airways and demonstrable and reversible obstruction. Pathologically, it is a chronic inflammatory disorder of the airways. The Global Initiative for Asthma (GINA) Updated in 2014 describes asthma as a heterogeneous disease, usually characterized by chronic inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness, and cough that vary over time and in intensity, together with variable airflow limitation. The operational definition as above is fairly broad and comprehensive, but lacks precision. It is particularly difficult from an epidemiological point of view for the assessment of burden and comparative analysis. More recently, asthma is described as a syndrome consisting of many disease entities because of the presence of a wide clinical heterogeneity and overlap syndromes. Further, asthma is recognized to present with a large number of systemic manifestations and other associations. Factually, asthma is now considered as a syndrome of a number of different diseases. These features make it even more difficult to define the disease and its epidemiology[8, 17, 112].

Diet Foods are frequently blamed to aggravate asthma. There are very few types of foods, which can be definitely identified as triggers. Fish, eggs, certain types of mushrooms, bananas, and some beans have been listed as triggers in some studies. Processed foods are also listed amongst causes of asthma in some studies. Breastfeeding during infancy is shown to be protective against asthma. On the other hand, infants fed with formula milk or soy proteins have higher incidence of asthma. The presence of gastro-oesophageal reflux (GER) is considered as an important trigger especially in patients with nocturnal asthma, though the relationship of GER with asthma has recently been disputed. It was shown in a large double-blind trial that silent GER was not a likely cause of poorly controlled asthma.

Occupational Asthma

It is first necessary to establish a diagnosis of asthma in a patient and then identify whether it is occupational asthma (OA). A thorough medical history and objective work-related testing usually provides a reliable diagnosis of occupational asthma. A detailed history for suspected OA includes chronological work history, job duties, exposures at work, onset and timing of symptoms, use of protective devices, presence of respiratory disease in co-workers, medication use, and past lung function. It would be very helpful to have up-to-date material safety data sheet (MSDS) in place for every chemical or material that may pose an occupational hazard for patients. MSDS contains information that will help identify the suspect agent in the workplace. Asthma and COPD Airway disease can manifest with four different components, which can exist in various combinations—(i) symptoms; (ii) bronchial hyper-responsiveness; (iii) variable airflow limitation; (iv) chronic airflow limitation; and (v) airway inflammation. Both asthma and COPD are physiological characteristics— while variable airflow limitation is a characteristic of asthma, chronic airflow obstruction is seen in COPD. On the other hand, airway inflammation indicates presence of bronchitis. Overlap of different components can occur in different patients with variable manifestations. These combinations can be labelled as overlap syndromes[17].

Airway re-modelling in overlap syndrome: - Subjects with severe asthma and chronic persistent obstruction have increased airway smooth muscle (15.65%) versus that (8.96%) seen in patients without chronic airflow obstruction; however, airway measurements on high-resolution computed tomographic scans revealed no differences between the groups.

Asthma and COPD overlap

Asthma and COPD overlap can be explained on the basis of the Dutch hypothesis, which considers that different types of airway diseases should be viewed as one entity with different components. The presence of one or more components is influenced by different host and environmental factors including tobacco smoke and air pollutants. Treatment in different patients is optimized depending upon the presence of different disease components. Finally, the rapid advances in the ‒omics‖ platforms such as proteomics, transcriptomics, and metabolomics may provide signatures, fingerprints, or perhaps

handprints of asthma that may become available for clinical use as point of care tests within the next few years[17, 112].

Diet and Asthma: -

The relationship between dietary nutrients and asthma has been suspected but evidence from prospective and randomized trials is lacking. For example, although there is an epidemiological association between low serum levels of vitamin D and the development of asthma, asthma severity and recurrent exacerbations, recommendations cannot be made for vitamin D supplementation based on the evidence available to date. General advice for patients with stable asthma is intuitive: eat a balanced diet comprised of natural, non-processed foods with ample fruits and vegetables. There is an association between obesity and risk for the development of asthma and, in addition, asthmatic patients with obesity generally have more severe disease with poorer control and decreased response to conventional treatment such as inhaled corticosteroid therapy.

Indications for mechanical ventilation in acute severe asthma.
• Cardiorespiratory arrest
• Coma
• Refractory hypoxemia
• Patient‘s condition refractory to initial management
• Drowsy, somnolent patient
• Cardiovascular compromise
• Failure of non-invasive ventilation

Table no. 9 -Indications for mechanical ventilation in acute severe asthma

<u>Role of nutrition in various lung diseases</u>

Nutrition plays a crucial role in the management and outcomes of various pulmonary conditions in the elderly population, including interstitial lung disease (ILD), lung cancer, acute respiratory distress syndrome (ARDS), pulmonary hypertension (PH), and pulmonary embolism (PE). Malnutrition, a common concern among the elderly, can significantly impact these conditions, exacerbating symptoms, impairing treatment efficacy, and influencing overall prognosis[17, 113].

Interstitial Lung Disease (ILD)

ILD encompasses a group of chronic lung disorders characterized by inflammation and fibrosis of the lung parenchyma. Nutrition is vital in ILD for several reasons:

Influence on Lung Function: Adequate nutrition supports respiratory muscle function and overall lung health, potentially impacting the progression of ILD. Impact on Immune Function: Proper nutrition supports immune function, which is crucial in managing inflammation and infection, common complications in ILD.

Weight Management: Maintaining a healthy weight can alleviate respiratory symptoms and reduce the strain on compromised lungs. Malnutrition in ILD patients can lead to muscle wasting, fatigue, and reduced exercise tolerance, worsening the quality of life and potentially accelerating disease progression[17, 113].

Lung Cancer

Nutritional status is critical in lung cancer patients due to the metabolic demands of cancer growth, treatment-related side effects, and the impact on overall health:

Energy Requirements: Cancer patients often experience increased energy needs due to metabolic changes and the energy demands of treatments like chemotherapy and radiation.

Nutrient Absorption: Cancer and its treatments can impair nutrient absorption, leading to deficiencies that further compromise health. Adequate nutrition supports immune function, aiding in recovery and reducing complications from infections.

Malnutrition in lung cancer patients can lead to treatment delays, increased susceptibility to infections, and poorer outcomes in terms of response to therapy and overall survival.

Acute Respiratory Distress Syndrome (ARDS)

ARDS is a severe form of acute lung injury characterized by widespread inflammation in the lungs, leading to respiratory failure. Nutrition plays a pivotal role in ARDS:

Modulating Inflammation: Certain nutrients have anti-inflammatory properties that may help mitigate the inflammatory response seen in ARDS.

Muscle Preservation: Maintaining muscle mass is essential to prevent complications such as prolonged mechanical ventilation and impaired physical function post-ARDS.

Malnutrition in ARDS can prolong ventilator dependence, increase complications such as infections, and hinder overall recovery and rehabilitation efforts[10, 17, 113].

Pulmonary Hypertension (PH)

PH is characterized by elevated blood pressure in the pulmonary arteries, leading to increased workload on the heart and potential right heart failure. Nutrition impacts PH in several ways:

Fluid and Salt Intake: Managing fluid and salt intake is crucial in PH to prevent fluid retention and exacerbation of symptoms.

Weight Management: Maintaining a healthy weight reduces strain on the heart and pulmonary vasculature.

Nutritional Supplements: Some patients benefit from specific nutritional supplements to support heart function and overall health.

Malnutrition in PH patients can worsen symptoms of fatigue, dyspnoea, and exercise intolerance, and may contribute to disease progression and poor prognosis.

Pulmonary Embolism (PE)

PE occurs when a blood clot lodges in the pulmonary arteries, causing obstruction and potentially leading to respiratory compromise. Nutrition is significant in PE management:

Anticoagulation Therapy: Nutrition can affect the metabolism and efficacy of anticoagulant medications used to treat PE.

Recovery and Rehabilitation: Proper nutrition supports recovery from PE, including lung healing and restoration of physical function.

Malnutrition in PE patients can delay recovery, impair mobility, and increase the risk of complications related to immobility and venous stasis.

Impact of Malnutrition on Elderly Population

In the elderly, malnutrition is particularly concerning due to age-related changes in metabolism, decreased appetite, dental issues, and comorbidities:

Muscle Wasting and Frailty: Malnutrition contributes to muscle wasting, frailty, and reduced physical function, exacerbating the impact of pulmonary conditions.

Immune Function: Aging reduces immune function, and malnutrition further compromises the ability to fight infections, a significant concern in pulmonary diseases.

Cognitive Function: Nutrition influences cognitive function, affecting adherence to treatments and overall management of chronic conditions.

Addressing malnutrition in the elderly requires a multidisciplinary approach involving healthcare providers, dieticians, and caregivers:

Assessment and Screening: Regular nutritional assessment and screening are essential to identify at-risk individuals and intervene early.

Individualized Nutrition Plans: Tailored nutrition plans address specific needs, ensuring adequate intake of calories, protein, vitamins, and minerals[17, 113].

Nutritional Support: This may include oral nutritional supplements, enteral feeding, or parenteral nutrition in severe cases where oral intake is inadequate.

In conclusion, nutrition plays a critical role in the severity and management of interstitial lung disease, lung cancer, acute respiratory distress syndrome, pulmonary hypertension, and pulmonary embolism in the elderly population. Malnutrition exacerbates symptoms, complicates treatment outcomes, and increases the risk of complications. Addressing nutritional needs through comprehensive assessment, personalized nutrition plans, and appropriate interventions is essential to optimize outcomes and improve quality of life for elderly patients with pulmonary conditions.

Hypoventilation/Hypoxemia Syndromes

While gas exchange parameters are important for the diagnosis of hypoventilation/hypoxemia syndromes, the causes of these gas exchange abnormalities is comprised of a heterogeneous group of disorders that affect the capacity of the respiratory system to adjust for sleep-related changes with respect to ventilatory control mechanisms and respiratory mechanics[10]. Disorders included in this group include neuromuscular and chest wall disorders, various pulmonary disorders, and idiopathic disorders (congenital central alveolar hypoventilation). The primary pathophysiology of nocturnal hypoxemia relates to an elevation of alveolar partial pressure of carbon dioxide and a subsequent reduction of alveolar oxygen, consistent with the alveolar gas equation; an alternate cause of hypoxemia likely relates to increasing ventilation and perfusion mismatch in poorly ventilated lung regions. Clinical features of alveolar hypoventilation include poor sleep quality, nocturnal and/or morning headache, daytime sleepiness and loss of energy, decreased intellectual performance, loss of appetite and weight loss, and features of progressive right heart failure/Cor-pulmonale[17]. Treatment for sleep-related hypoventilation/ hypoxemia syndromes is disorder-specific, although non-invasive ventilation in the bi-level mode is often a necessary adjunctive measure utilized in all of these disorders; short-term improvement in clinical symptoms and the suggestion of a mortality benefit, particularly in individuals with neuromuscular disease, is present when non-invasive ventilatory support is utilized. Neuro-muscular disorders that may result in nocturnal hypoventilation/ hypoxemia includes amyotropic lateral sclerosis (ALS). Individuals with ALS, a neurodegenerative disorder characterized by loss of motor neurons and resultant progressive weakness and atrophy of skeletal muscles including accessory muscles of respiration, are at risk for both diurnal and nocturnal hypoventilation/hypoxemia. Although the diminished function of respiratory muscles is the primary defect in neuromuscular disorders during sleep, individuals with chest wall disorders (kypho-scoliosis, ankylosing spondylitis, trauma, pleural disease, history of thoracoplasty, and obesity) and pulmonary disease (COPD, asthma, IPF, and CF) are at risk for nocturnal hypoventilation/hypoxemia due to several additional mechanisms. Bursts of rapid eye movements occurs during REM sleep causing decreased functioning of the accessory muscles of respiration; ventilation and gas exchange thus depend solely on the diaphragm. During wake, individuals with chest wall and/or pulmonary disease may already have gas exchange abnormalities due to their underlying disease; normal

increases in PaCO2 associated with sleep onset compounds the underlying gas exchange problems, resulting in worsening hypoxemia. Obesity results in reduced chest wall compliance due to the mass load placed on the thoracic cage; the reduction in compliance is further exacerbated in the supine position, worsening ventilatory function during sleep by increasing the work of breathing[114].

Respiratory sleep disorders are among the most common diseases affecting humans and encompass a wide spectrum of diseases. These range from obstructive sleep apnoea/hypopnea syndrome (OSAHS) where the pathology is peripheral to central sleep apnoea (CSA) where the respiratory centre is involved. The field of sleep medicine is heavily dominated by OSAHS, which is the most common sleep disorder. The introduction of positive airway pressure (PAP) therapy led to a revolution in the field, with newer devices and treatments announced on a regular basis.

Oxygen Therapy: - Hypoxemia is a grave and immediate threat to organ function. Oxygen therapy is started immediately on admission after an arterial blood sample is obtained for assessment of blood gas tensions. The goal of supplemental oxygen is to maintain a PaO_2 of 55–60 mm Hg corresponding to SpO_2 of 89–92%. Administration of excess amounts of oxygen can blunt this ventilatory drive with resultant hypercapnia and acute respiratory acidosis superimposed on type-2 respiratory failure that could be potentially life threatening. Excess oxygen therapy has been shown to prolong hospital stay probably because it can lead to generation of harmful reactive oxygen species, which can exacerbate tissue injury. Excess oxygen can also lead to hypercapnia by ventilation perfusion disturbances, Haldane effect and by causing numerous areas of micro-atelectasis. Another reason why PaO_2 is not increased more than 60 mm Hg is because it corresponds to oxygen saturation (SaO_2) of around 90%; from the oxygen content equation, we can conclude that there is no benefit of increasing PaO_2 above 60 mm Hg except in situations of hyperbaric oxygen delivery. In acute situations, it is always better to use high-flow devices as one can, to a reasonable extent, guarantee the oxygen delivered. On the other hand, with the use of a low flow device, oxygen delivery would not be dependent on the patient‘s minute ventilation. Once the patient has been stabilized, one can shift to nasal prongs, as it proves more comfortable for the patient.

Non-invasive Ventilation: - Non-invasive ventilation (NIV) is provision of pressure support plus continuous positive airway pressure (CPAP) via a nasal or facemask during

inspiration, i.e. without an endotracheal airway. CPAP is not traditionally a ventilatory mode since it does not actively assist inspiration. CPAP is considered a form of NIV only when used for management of respiratory failure. Non-invasive ventilation success depends upon proper fit and comfortable interface (mask) and ventilator settings. Full-face masks are used for ARF whereas nasal masks are preferred for the chronic setting. The optimal ventilator settings are determined by the ability to reduce the work of breathing against the discomfort imposed by high pressures. This is assessed clinically by reduction in respiratory rate to less than 30–35 breaths per minute- usually more than 8–10 cm H_2O. With the remarkable success of NIV in COPD, it has been tempting to try and use this in the setting of asthma, which seems similar. However, most trials do not show unequivocal benefit in asthma. NIV must be used cautiously, if at all in asthma. The mask should not be allowed to delay or interfere with inhaled therapy in any case. There are constant efforts to try and expand the role of NIV beyond the currently accepted four settings mentioned above. In these, benefit has been proven beyond doubt[8, 10, 17, 114].

Endotracheal Intubation and Invasive Ventilation: - Patients who are in severe respiratory distress and those who fail treatment with oxygen and NIV generally require endotracheal intubation and invasive ventilation. Another indication for intubation is airway protection in patients with altered mental status. The aim of invasive ventilation is to correct hypoxemia and maintain alveolar ventilation appropriate to patient‘s metabolic requirements[115]. An important consideration is the ventilator that should be used for mechanically ventilating these patients. No ventilator is clearly better than any other. The machine is selected on the basis of the spectrum of patients, the financial resources of the ICU and the available expertise in handling the equipment. Clearly, the people operating the ventilator are more important than the machine. One controversial area is the choice of a volume controlled or pressure controlled strategy. There is no strong evidence base for the pressure controlled ventilation although logically it is likely to be equivalent to the volume-controlled mode because it is the settings rather than the mode that is the important issue[17, 116]. It is best to initiate ventilation with a volume assist-controlled mode ventilation and once the patient improves, shift the patient to pressure support ventilation. Newer modes of ventilation are increasingly being promoted to decrease the hazards of conventional ventilation and improve patient–ventilator interactions. However, none of the newer mode of ventilation has been shown superior to conventional modes. Also, the

indications, efficacy and safety are still clinically uncertain and are not being widely utilized.

Extracorporeal Membrane Oxygenation: - The use of ECMO for severe ARF in adults continues to expand, in spite of the lack of evidence justifying its use. ECMO should be utilized in centres with availability of sufficient expertise to ensure its safety. It is the most useful intervention in ARDS not responding to other measures. Significant benefit is seen if analysis is restricted to better quality studies of veno-venous ECMO and the subgroup with H_1N_1. Benefits in reversing hypoxemia may not necessarily translate into mortality benefit. Complications such as renal failure, pneumonia or sepsis, and bleeding are frequent. In conclusion, the management of respiratory failure hinges on two basic principles, i.e. oxygen therapy for alleviation of hypoxemia and aggressive treatment of basic disease. Oxygen should be administered through highflow (Venturi mask) system. ECMO is useful in patients who remain hypoxemic despite 100% oxygen[17, 117].

Psychological causes of involuntary weight loss

Poverty	Inability to purchase food	Alcoholism
Social isolation	Inability to cook	Depression
Bereavement	Inability to feed	Paranoia

Table no.-10 - Psychological causes of involuntary weight loss

Medical causes of involuntary weight loss

Gastro-intestinal cancer	COPD	Oral or dental problems
Lung cancer	Dementia	Gall stones
Lymphoma	Endocrine disorder	Peptic ulcer disease
Prostate cancer	End stage Renal failure	G.I. Motility disorder
Ovarian cancer	End stage Liver failure	Diabetes mellitus
Bladder cancer	Stroke	Hyperthyroidism
Pancreatic cancer	Rheumatoid arthritis	Mesenteric ischemia

Table no.-11 Medical causes of involuntary weight loss

Medications causing involuntary weight loss

Anorexic Medications	**Nausea & vomiting**	**Alter taste & smell**
Erythromycin	Bisphosphonates	ACE inhibitors
Digoxin	Dopamine agonists	Calcium channel blokers
Opiates	Tricyclic antidepressants	Spironolactone
SSRIs	SSRIs	Anticholinergic
Amantadine	Loop diuretics	Antiparkinsons drugs
Metformin	Antihistamines	Iron treatment
Benzodiazepine	NSAIDs	Metronidazole

Table no. 12- Medications causing involuntary weight loss

Strategies for management and prevention of malnutrition

Nutritional screening and assessment:

Early and accurate nutritional assessment is vital in managing malnutrition in elderly ICU patient with respiratory diseases. Implementing routine nutritional assessment upon admission and regularly throughout the ICU stay can help identify a patient at risk of malnutrition early. Using comprehensive tools that consider both clinical and biochemical parameters can improve the detection of malnutrition.

Individualized nutritional support:

Once malnutrition is identified, tailored nutritional interventions should be initiated promptly. Enteral nutrition (EN) is modality of choice in comparison to parenteral nutrition (PN) when possible, as it maintains gut integrity and reduces infection risks. The nutritional plan should be individualized based on specific needs of the patient population, disease severity, basal metabolic rate, and existing comorbidities.

Multi-disciplinary approach:

A multidisciplinary approach including Physicians, Dieticians, Nurses, and Respiratory Physiotherapists is essential for effective nutritional management. Regular team meeting to discuss and up-date the nutritional care plan to ensure that all aspects of patient‘s

health are addressed. This collaborative effort helps in optimizing the patient's nutritional status and over-all health outcome while he is admitted in ICU.

Monitoring and adjusting nutritional interventions:

Continuous monitoring and adjustment of nutritional plan and interventions are crucial to meet the needs of the elderly patients admitted in ICU. Regular assessment of the nutritional intake, tolerance, and clinical response helps in making necessary adjustments to the on-going nutritional plan. Monitoring parameters like weight, muscle mass, serum albumin levels, anthropometric parameters and inflammatory markers can provide insights into the effectiveness of the intervention.

Conclusion

As the ageing population is growing world-wide, so is the risk of malnutrition in elderly population. There is a high prevalence of malnutrition in elderly population, and the prevalence increases manifold in hospitalized elderly patients. The reason for high prevalence of malnutrition are many and includes-multi-morbidity, atypical disease presentation, delay in seeking medical consultation due to various psycho-socio-economic factors and also includes the fear of hospital admission in elderly age group.

Disease and illness in itself is a risk factor of malnutrition and eating fewer than two meals a day adds to this problem. The frail elderly adult may be requiring assistance for self-care and for his activities of daily living. He may be suffering from tooth loss or mouth pain, chewing difficulty, economic hardships to buy food stuff, reduced social contact or may be facing involuntary weigh loss.

Malnutrition has profound effect on respiratory function. Malnutrition causes significant respiratory pathologies including increased risk of respiratory infections, impaired lung function, and increased risk with delayed recovery from subsequent acute or chronic respiratory diseases. This includes asthma, COPD, and lung cancer.

Patients with COPD are mostly severely undernourished for proteins. The main mechanism is hyper-metabolism, which is responsible for increased oxygen consumption by the malnourished respiratory muscles[118]. One of the most important cause of the atrophy and decreased strength of respiratory muscles, decreased exercise performance,

decreased quality of life and increased risk of hospital acquired or community-acquired Pneumonia is malnutrition.

It is important to evaluate every elderly about his food–energy status and nutritional habits. Asking about his appetite, how much food intake makes him feel full, how frequently he feels hungry during the day, how the food tastes to him now and how it tasted when he was 45 years of age? It is imperative to communicate to the older adult about the importance of eating three regular meals, about healthy-enjoyable eating and to make him understand the link between nutrition and well-being[17,119].

Mini Nutritional Assessment-short form (MNA-SF®) is an easy and reliable screening tool for physician, dietician, medical students or nurses to quickly evaluate the nutritional status of elderly adults. MNA-short form (MNS-SF®) can be executed on patient in 5 minutes and includes questions relating to last 3 months, such as- mobility, decreasing weight, psychological stress, acute disease, dementia or depression and measures calf circumference. A low MNA-SF® score (0-7) represents malnutrition; a high score (12-14) represents normal nutrition status and an intermediate score (8-11) represents risk of malnutrition. MNA-SF® is an ideal tool for the evaluation of older adults with high specificity, sensitivity, negative and positive predictive values and a high validity. It allows evaluator to replace BMI value with calf circumference, considering the fact that it is usual for elderly to have age related spine changes with shortening of height, wherein BMI will not be the true representation of nutritional status. Moreover, critically ill patients are bed bound and can‘t be lifted to measure weight in a normal ICU settings.

Malnutrition can significantly worsen outcomes in patients, increasing both mortality and morbidity. Nutritional screening directs clinician‘s attention to this prevalent clinical issue, serving as the initial step towards implementing a structured approach to patient care where addressing malnutrition is integral to therapy. Malnourished patients face heightened risks of mortality and morbidity, which can exacerbate existing conditions like chronic lung disease, sepsis, trauma, and cardiovascular dysfunction. Importantly, many consequences of malnutrition can be partially reversed through proper re-feeding strategies. Further research is needed to determine the meaningful impact of these interventions on the outcomes of elderly patients hospitalized in the ICU for respiratory illnesses[10,17,120].

Addressing malnutrition through systematic nutritional screening is crucial as it allows healthcare providers to identify patients at risk early on. This approach not only highlights the problem but also integrates nutritional correction as a fundamental part of patient therapy. Importantly, many of the adverse effects of malnutrition can be partially reversed with appropriate re-feeding strategies. In the context of elderly patients hospitalized for respiratory pathologies and admitted to the ICU, it becomes even more critical to establish effective nutritional interventions. Further studies will be needed to determine the impact of such measures on both morbidity and mortality outcomes in this vulnerable population.

Materials and method

Our study was hospital based cross-sectional study conducted on 68 patients admitted in the wards with history of clinical findings and radiological evidence for ischemic stroke in BLDE-DU, Shri B M Patil Medical College and Research Centre, Vijayapura, after getting approval from the institutional ethical committee.

Method of collection of data

The data is collected according to Pro-forma in terms of detailed history, clinical examination and necessary investigations of the patients who fulfil the inclusion criteria.

Patient presenting with symptoms of Respiratory Disease

Subjected to History taking, physical examination and radiological examination

Features suggestive of Respiratory disease with a need to admit in ICU

Features suggestive of Respiratory disease with co-morbidity

Patient admitted in the critical care unit (ICU)

Subject enrolled in the study, Nutritional Assessment done using MNA-SF® & Lab Investigations sent and reports collected on Numar

STUDY DESIGN:

Hospital based cross-sectional study.

PERIOD OF STUDY: From 1st September 2022 to 12th September 2023.

Sample size

With the anticipated proportion of abnormal Serum ferritin level among Ischemic stroke cases 34.5%, the study would require a sample size of **82 subjects** with 95**%** level of confidence and 10% absolute precision**.** For the convenience of statistical analysis the sample size was kept at **100 patients** as sample size for the present study**.**

Formula used

- $$n = \frac{z2\ p*q}{d2}$$

Where Z= Z statistic at α level of significance

d2= Absolute error

P= Proportion rate

q= 100-p

Statistical Analysis

- The data obtained will be entered in a Microsoft Excel sheet, and statistical analysis will be performed using statistical package for the social sciences (Version 20).
- Results will be presented as Mean (Median) ±SD, counts and percentages and diagrams.
- For normally distributed continuous variables will be compared using independent t-test. For not normally distributed variables Mann Whitney U test will be used. Using the Chi-square test categorical variables will be compared.
- Correlation between variables will be found by Pearson‘s/Spearman‘s correlation.
- **P<0.05** will be considered statistically significant. All statistical tests will perform two-tailed.

Inclusion criteria:

1. All the patients above 60 years irrespective of sex who admitted in the critical care unit (ICU) of the BLDE-DU hospital due to Respiratory diseases confirmed by presenting complaint, history, physical examination, laboratory findings and radiological examination were included in the study.

Exclusion criteria:

1. Patient who had abdominal surgery in the past six weeks.
2. Patients who suffered from a recent stroke in the past six weeks.
3. Patients who were intubated and on mechanical ventilation at admission.
4. Patients who were on enteral or parenteral nutrition at admission.
5. Patients with diagnosis of malabsorption syndrome for the past six weeks.
6. Patients with diagnosis of inflammatory bowel disease for eight weeks duration.
7. Patients with diagnosis or treatment of upper Gastro-intestinal tract cancer.

Results

Characteristic features of study population

Age wise distribution

The results of the presented study conducted to evaluate the nutritional status and its impact on elderly patient with respiratory diseases admitted in critical unit of our hospital are summarized in table no. 1 and the detailed discussion of the results is as follows:-

In our study mean age observed was 69.11 ±7.82 years. We categorized age into 60 – 74 years, 75 – 84 years, and 85 – 92 years, with 74%, 18% and 08% of patients respectively and together constituted the study sample. Majority of the patients in our study belongs to 60-74 years (Young old) category. The oldest patient in our study was of 92 years of age.

Table no.-13 & Figure no. - 1.

Age wise distribution	Percentage
60 to 74	**74%**
75 to 84	**18%**
85 to 92	**8%**

TABLE NO: 13- Age wise distribution of study population

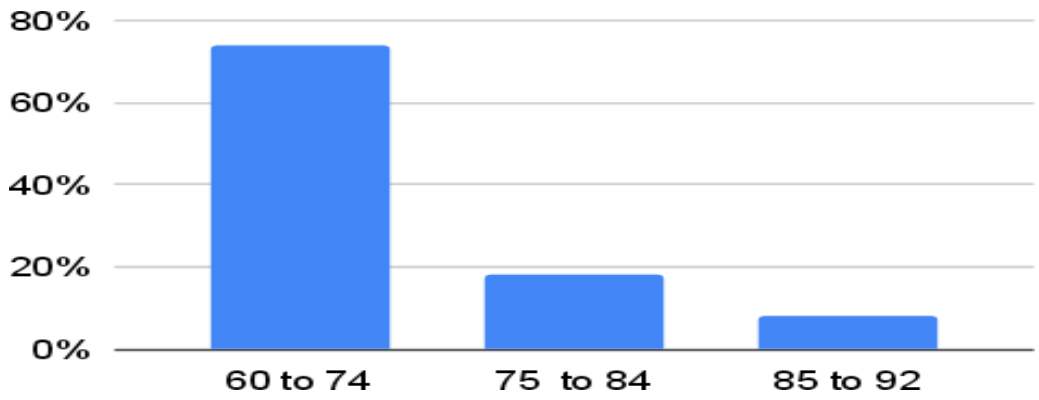


Figure no. 1- Age wise distribution of study population

S. No.	Characteristic features	Value
	Sample size total no. of patients	100
A.	Gender wise distribution	
	Male	53%
	Females	47%
B.	Age wise distribution	
	60-74	74%
	75-84	18%
	85-92	08%
C.	Mean ± SD of age in years	
	Males	69.17±8.48
	Females	69.04±7.09
	Mean	69.11±7.82
D.	Diet	
	Vegetarian	35%
	Mixed	65%
E.	Appetite	
	Normal	52%
	Reduced	48%
F.	Mid-arm circumference (MAC) (cm)	
	≤ 22.5 cm	19%
	>22.5 cm	81%
G.	Mini nutritional assessment- short form (MNA-SF®)	
	I- Malnourished (0-7)	17%
	II- At risk of malnutrition (8-11)	40%
	III- Normal nutrition status (12-14)	43%
H.	Duration of hospital stay (Days)	
	Below 10 days	58%
	10-29 days	24%
	Above 20 days	18%
I.	Need for Oxygen or mechanical ventilation	
	Mechanical ventilation	32%
	Non-invasive ventilation (NIV)	28%
	Oxygen by mask	26%
	No Oxygen requirement	14%
J.	Haemoglobin levels (gm/dL)	
	Less than 13	72%
	13-17	28%
K.	Total leukocyte counts (per cubic mm)	
	Less than 4,500	02%
	4,500-11,000	60%
	More than 11,000	38%
L.	Mean corpuscular volume (fL)	
	Less than 80	30%
	80-100	57%
	More than 100	13%
M.	Serum Creatinine (mg/dL)	
	Less than 0.7	28%
	0.7-1.3	38%
	More than 1.3	34%
N.	Out-come of patients	
	Discharge against medical advice (DAMA)	19%
	Death	10%
	Discharge with follow-up (DFU)	71%

Table No. – 14 Characteristic features of study population

Gender-wise distribution

In our study population of 100 patients, most of the patients were male 53% and female constituted 47%.**Table no. -15** & **Fig. no. – 2.**

Gender wise distribution	Percentage
Male	**53%**
Female	**47%**

Table no: 15- Gender wise distribution

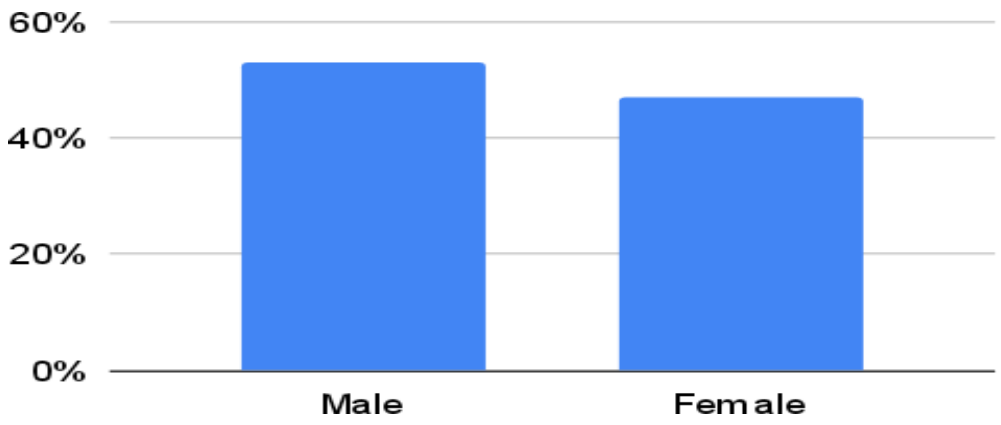


Figure no. - 2. Gender wise distribution

Mean and standard deviation of age (in years)

In our study, the mean age ± SD for male patients is 69.17±8.48 years and with 53% of the study population being male is comparable to the mean age of female population of 69.04±7.09 years, which is comparable. Table no:R3 & Figure no:R3

Mean + SD of age(in years)	Percentage
For Male	**69.17±8.48**
For Female	**69.04±7.09**
Mean	**69.11±7.82**

Table no- 16 Mean± SD of age (in years)

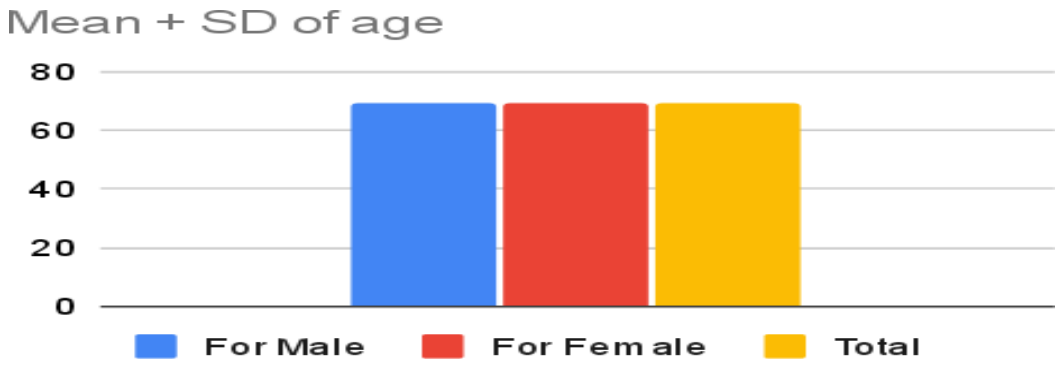


Figure no. 3- Mean±SD of age (in years)

Dietary pattern and appetite pattern of the study population

Majority (65%) of study population consumes mixed diet and only 35 % of elderly patients were vegetarian. 52% study population of elderly reported normal appetite, while 48% reported a reduced diet. Table no. 18 & 19 & Figure no. 4 & 5

Diet	Percentage
Vegetarian	35%
Mixed	65%

Table no- 17 Dietary pattern and appetite of the study population

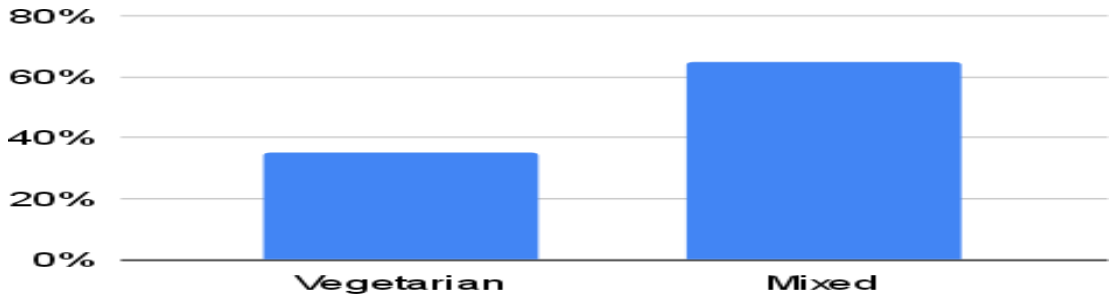


Figure no.4- Dietary pattern of the study population

Appetite	Percentage
Normal	52%
Reduced	48%

Table no. - 18 Appetite pattern of the study population

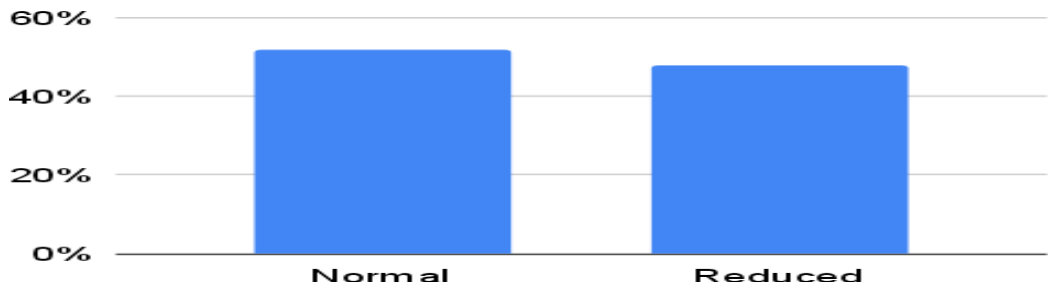


Fig no. 5- Appetite pattern of the study population

Anthropometric findings of the study population

In our study, it was found that 19% of the population had mid-arm circumference (MAC) of less than or equal to 22.5 cm and 81% of them had MAC of more than 22.5 cm. Table no: 19 & Figure no: 6

Mid-Arm Circumference (in cm)	Percentage
<22.5 cm	19%
>22.5 cm	81%

Table no. 19- Mid-Arm Circumference

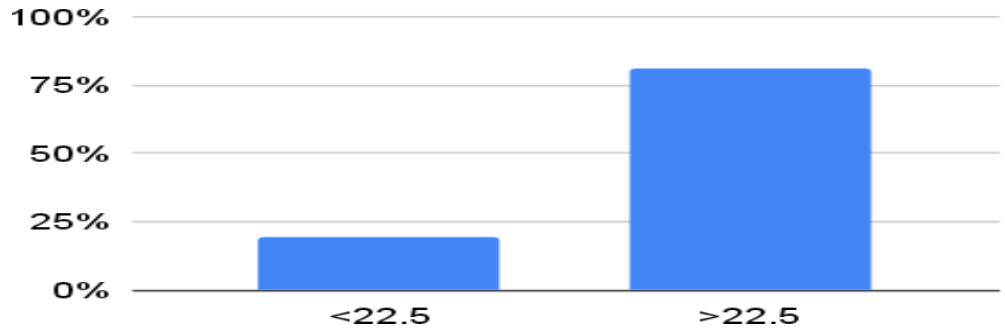


Fig no. 6- Mid-Arm Circumference

Mini nutritional assessment-short form (MNA-SF®) scores of the study population

In the present study, 17% of the elderly subjects had MNA-SF® score between 0 to 7, which represent ‑malnourished‖ status, 40% had a score in the range of 8 to 11, which represent ‑at risk of malnourishment‖ status and 43% of the elderly subjects of this study had score between 12 to 14, representing ‑normal nutritional‖ status. Table no: 20 & Figure no: 7

MNA-SF® score	Percentage
Malnourished (0-7)	17%
At Risk of Malnourishment (8-11)	40%
Normal Nutritional Status(12-14)	43%

Table no. 20 - MNA-SF® score

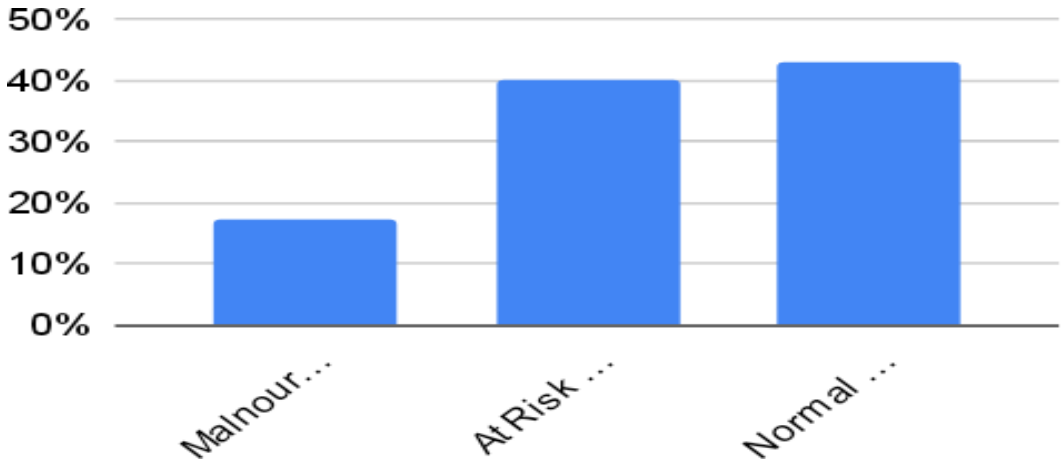


Figure no. 7- MNA-SF® score

Duration of stay in the hospital

Majority of patients (58%) stayed the hospital for less than 10 days, 24% of the patients had their stay between 10 to 20 days and 18% stayed for more than 20 days as depicted in the table no: 21 and the figure no: 8.

Duration of hospital stay (days)	Percentage
Below 10 days	58%
10 to 20 days	24%
Above 20 days	18%

Table no. 21- Duration of hospital stay

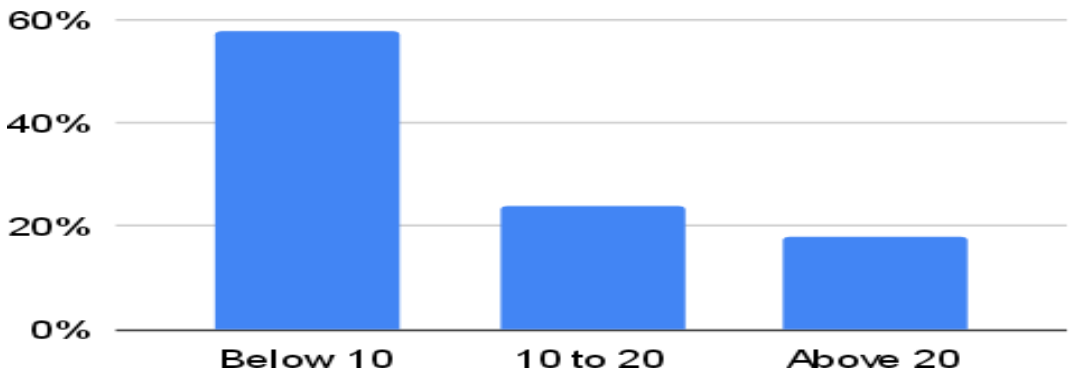


Fig no. 8- Duration of hospital stay

Need for Oxygen of ventilation in patient population

32% of the patients were admitted to the critical unit (ICU) of the hospital as they required mechanical ventilation. 28% of patients required non-invasive ventilation (NIV).While 26% of patients were given Oxygen via face-mask, 14% of patients maintained their Oxygen levels on their own and were not given Oxygen. Table no: 22, Figure no: 9

Need For O_2 or Ventilation	Percentage
Mechanical Ventilation	32%
O_2 via Mask	26%
Non-invasive ventilation (NIV)	28%
No O_2 Requirement	14%

Table no. 22- Need for O_2 or Ventilation

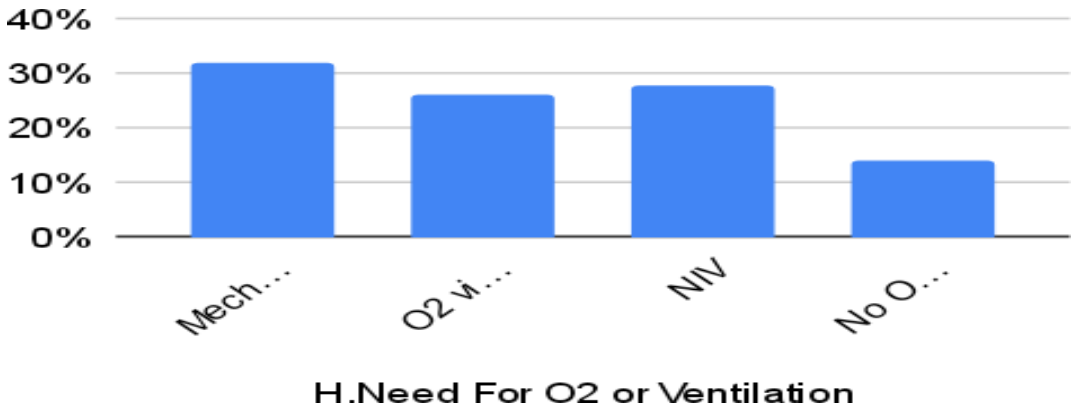


Fig no. 9- Need for O_2 or Ventilation

Biochemical evaluation of admitted patients

In the present study, 72% patients were anaemic with haemoglobin levels less than 13gm/dL. While 30% patients had microcytic cells with mean corpuscular volume of less than 80 femto-liter, only 13% were found to have mean corpuscular volume of more than 100 femto-liter, indicating macro-cytosis. 38% patients were found to have leucocytosis with total leukocytes counts more than 11,000/cu.mm. Of all the elderly patients admitted in ICU with respiratory diseases, 34% patients were found to have their serum Creatinine level of more than 1.3mg/dL, indicating deranged renal function. Table no.-23, 24, 25, 26 & Figure no.-10,11,12,13

Haemoglobin (gm/dL)	Percentage
Less than 13	72%
13 to 17	28%

Table no. 23- Haemoglobin concentration

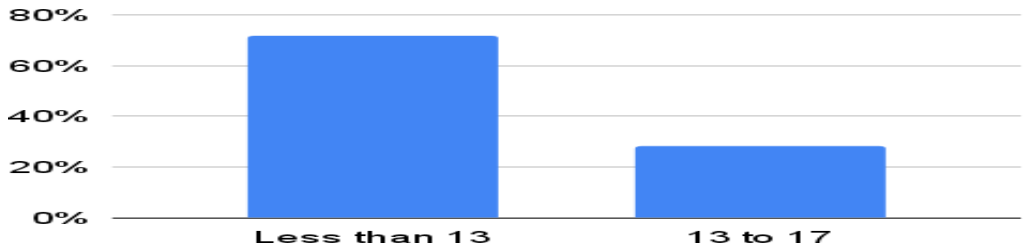


Fig no. 10- Haemoglobin concentration

TLC (per cu.mm)	Percentage
Less than 4500	2%
4500 to 11000	60%
More than 11000	38%

Table no: 24 Total leukocytes count (TLC)

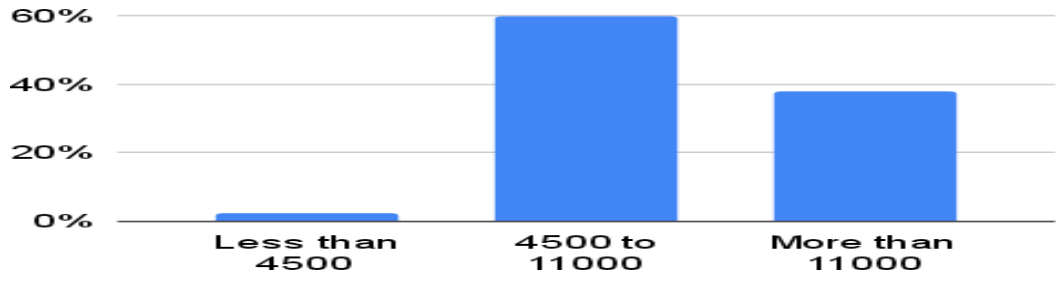


Figure no. 11- Total leukocytes count (TLC)

MCV (fL)	Percentage
Less than 80	30%
80 to 100	57%
More than 100	13%

Table no. 25- Mean corpuscular volume (MCV) (fL)

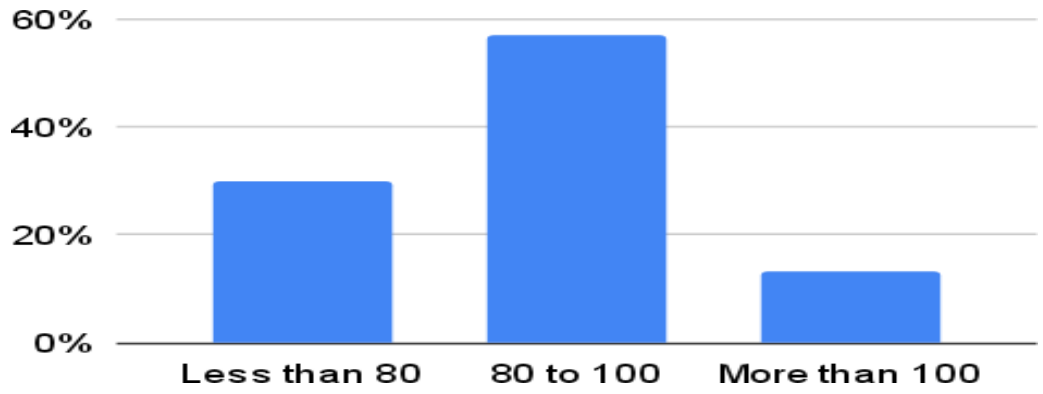


Figure no. 12- Mean corpuscular volume (MCV) (fL)

Serum Creatinine (mg/dL)	Percentage
Less than 0.7	28%
0.7 to 1.3	38%
More than 1.3	34%

Table no. 26 - Serum Creatinine levels

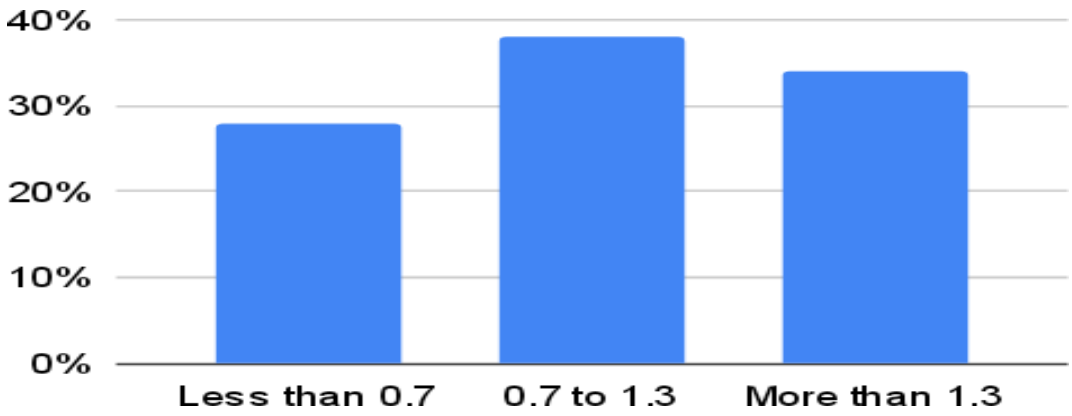


Figure no. 13- Serum Creatinine levels

Out-come of the patients

Based on the type of out-come, patients in the study were divided into three categories. Majority (71%) of patients was discharged with an advice to follow-up (DFU) for the treatment plan, 19% of patients were discharged against medical advice (DAMA) and 10% of the patients died in the present study. Table no. 27 & Figure no. 14.

Out Come of Patients	Percentage
DAMA	**19%**
Death	**10%**
Discharge with Follow-up	**71%**

DAMA- Discharge against medical advice

Table no. 27- Out-come of Patients

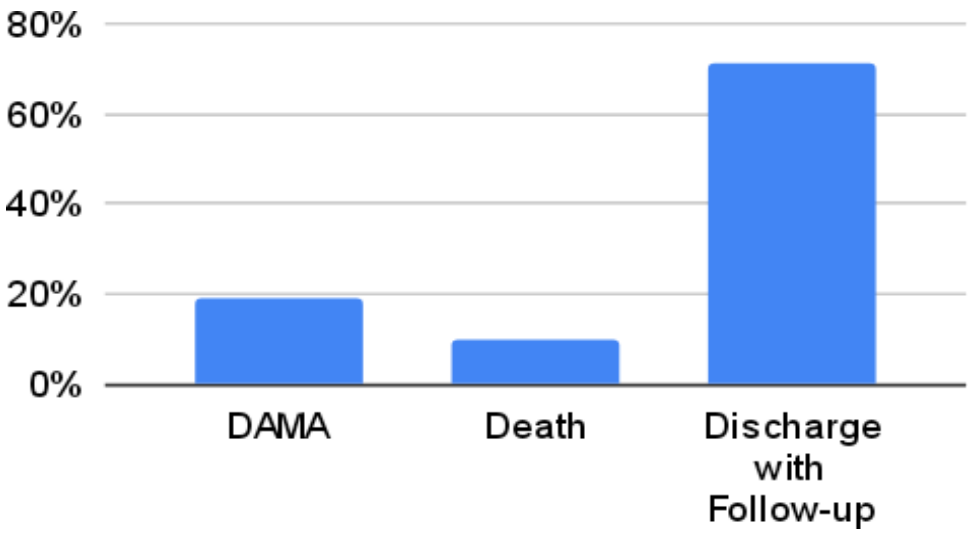


Figure no. 14- Out-come of Patients

Categorization of data on the basis of MNA-SF®

Association between genders and various MNA-SF® categories

There were 10% of males and 7% of females that fall in the category of being malnourished. Equal percentage (20%) of males and females were at risk of malnutrition in the present study, with 23% of males and 20% of females were adequately nourished. The results were not significant with p value of 0.8269 thus indicating there is no association between gender and nutritional status in our study. Table no. 29 and Figure no. 15, (continued on page no. 98).

Categorization of patients according to MNA-SF® score

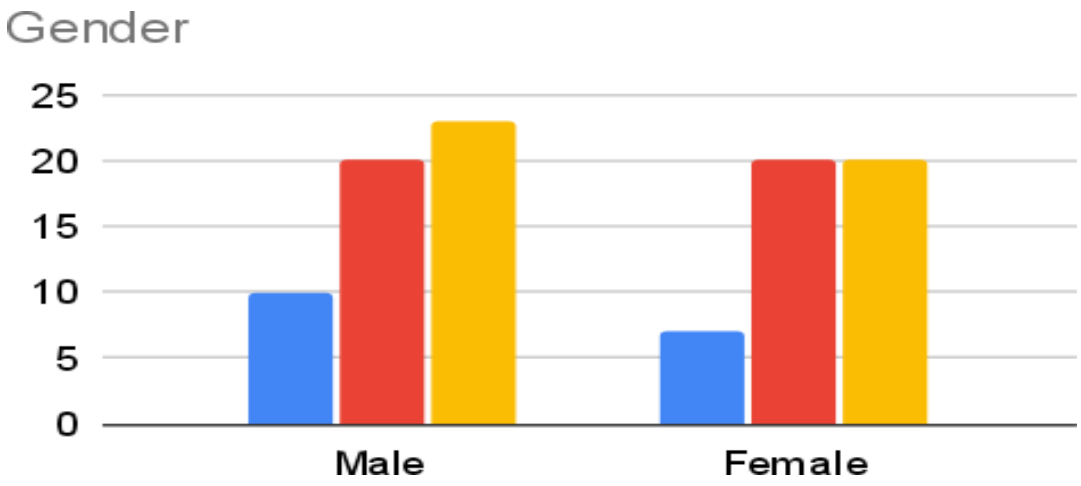
Parameters	MNA-SF® Categories			p-value
	I (0-7)	II (8-11)	III (12-14)	
Gender				
Male	10	20	23	0.8269 (NS)
Female	07	20	20	
Age group (Years)				
60-74	10	32	32	0.4472 (NS)
75-84	04	06	08	
85-92	03	02	03	
Type of diet				
Vegetarian	05	18	12	0.2296 (NS)
Mixed	12	22	31	
Appetite				
Normal	07	19	26	0.3078 (NS)
Reduced	10	21	17	
Mid-arm circumference (MAC)				
≤ 22.5 cm	09	09	01	<0.0001 (S)
>22.5 cm	08	31	42	
Duration of hospital stay (Days)				
Below 10 days	02	28	28	<0.0001 (S)
10-20 days	03	08	13	
Above 20 days	12	04	02	
Need for Oxygenation or ventilation				
Mechanical ventilation	12	14	06	0.0018 (S)
Oxygen by mask	02	12	12	
Non-invasive ventilation	02	11	15	
No Oxygen requirement	01	03	10	
Out-come of patients				
DAMA	07	06	06	< 0.0001 (S)
Death	06	03	01	
Discharge with follow-up	04	31	36	
Haemoglobin levels (gm/dL)				
Less than 13	17	24	31	0.0088 (S)
13-17	00	16	12	
Total leukocyte count (TLC) (cu mm)				
Less than 4500	01	00	01	0.0102 (S)
4500-11,000	06	32	22	
More than 11,000	10	08	20	
Mean corpuscular volume (MCV)(fL)				
Less than 80	07	20	03	0.0006 (S)
80-100	08	16	33	
More than 100	02	04	07	
Serum Creatinine (mg/dL)				
Less than 0.7	02	12	14	0.0023 (S)
0.7-1.3	02	18	18	
More than 1.3	13	10	11	

Master table no. 28 Categorization of patients according to MNA-SF® score

Gender	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Male	10	20	23	0.8269 Non-significant
Female	7	20	20	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 29- Gender versus MNA-SF® categories



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Figure no. 15- Gender versus MNA-SF® categories

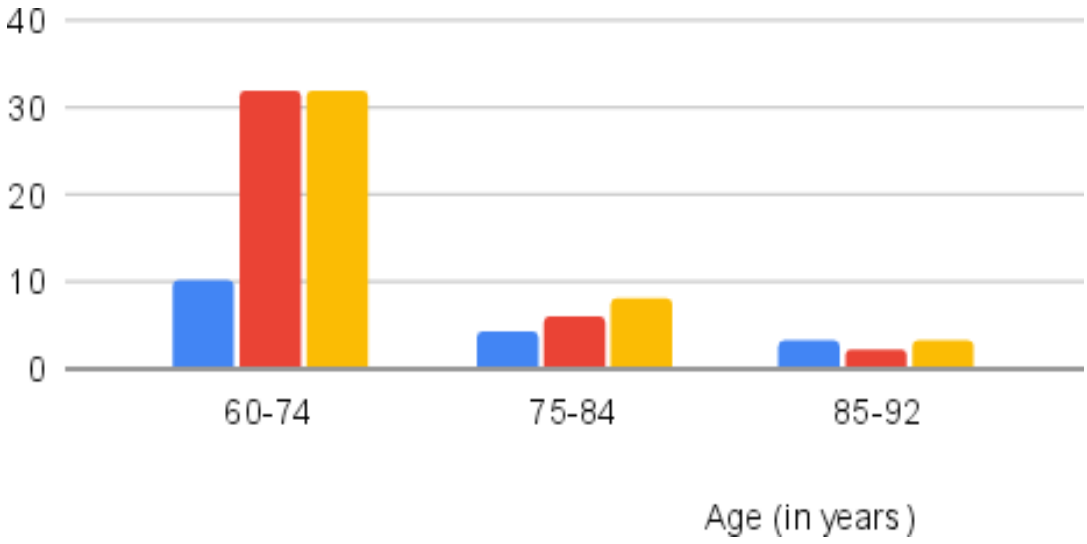
Association between age groups and various MNA-SF® categories

In the present study, in 60 to 74 years age group there were 10% found to be malnourished, 32% of patients at risk of malnourishment and 32% of patients were normally nourished. In 75 to 84 years category, there were 4% of patients who were found to be malnourished, 6% were at risk of malnourishment and 8% were normally nourished. In 85 to 92 years category, 3% were malnourished, 2% were at risk of malnutrition and 3% of patients were normally nourished. The findings were not significant (p-0.4472) indicating there is no association between age and nutritional status. Table no. 30 and Figure no. 16.

Age (in years)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
60-74	10	32	32	0.4472 Non-significant
75-84	4	6	8	
85-92	3	2	3	

MNA-SF® I: Score 0-7- Malnourished- Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Table no. 30- Age groups versus MNS-SF®



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Figure no. 16- Age groups versus MNS-SF®

Association between dietary pattern and various MNA-SF® categories

In our study 5% of patients on vegetarian diet and 12% of patients consuming mixed diet were found to be malnourished. There were 18% of vegetarian and 22% on mixed diet were at risk of malnourishment. 12% of vegetarian and 31% of patients consuming mixed diet were normally nourished. Although, more percentage of patients on mixed diet was not malnourished, overall this association was found to be non-significant (p-0.2296). Table no. 31 and Figure no. 17.

Diet	MNA-SF® I	MNA-SF® I	MNA-SF® III	p-value
Vegetarian	5	18	12	0.2296 Non-significant
Mixed	12	22	31	

MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Table no. 31- Dietary pattern versus MNA-SF® categories

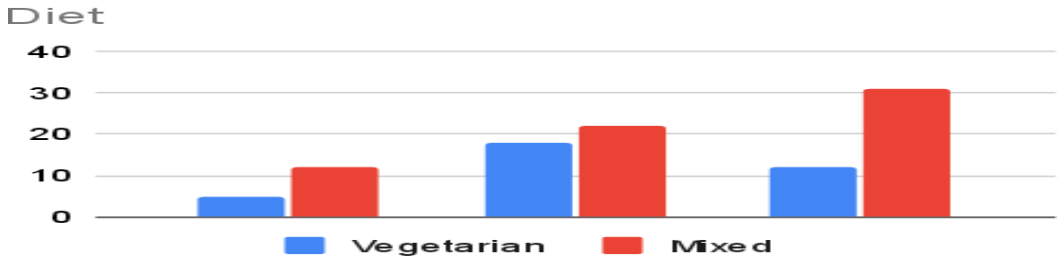


Figure no. 17- Dietary pattern versus MNA-SF® categories

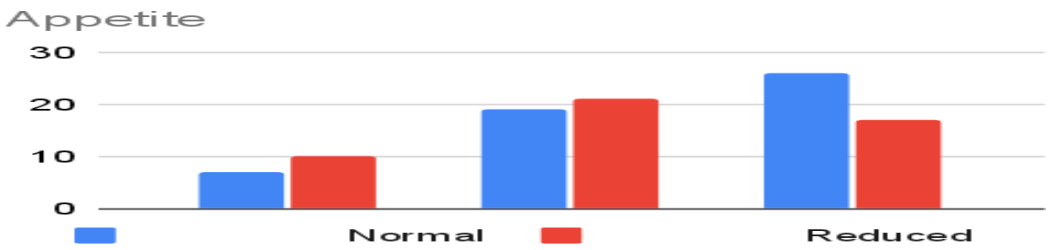
Association between appetite and various MNA-SF® categories

In normal appetite category, 7% of patients were malnourished, 19% were at risk of malnourishment and 26% were normally nourished. In decreased appetite category, 10% of patients were malnourished, 21% were at risk of malnourishment and 17% were normally nourished. Although there were more percent of patients with reduced appetite that fall in the category of malnourishment and at risk of malnourishment, the research findings were not significant (p-0.3078). Table no. 32 and Figure no. 18.

Appetite	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Normal	7	19	26	0.3078 Non-significant
Reduced	10	21	17	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 32- Appetite versus MNA-SF® categories



MNA-SF® I **MNA-SF® II** **MNA-SF® III**

Figure no. 18- Appetite versus MNA-SF® categories

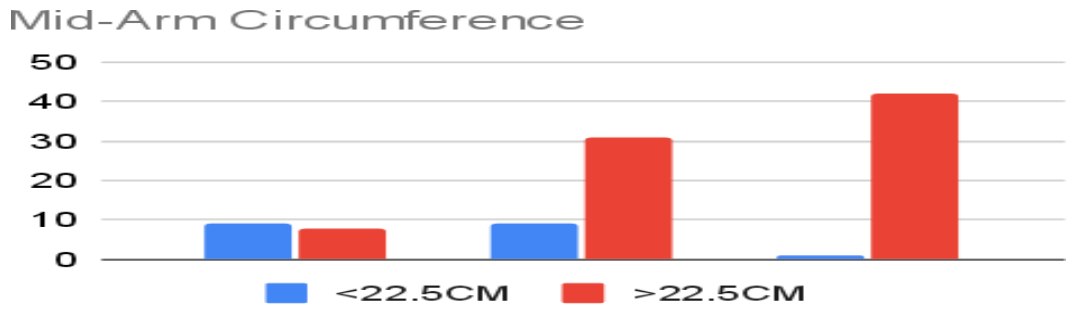
Mid-arm circumference (MAC) versus various MNA-SF® categories

MAC has two categories, in MAC of less than equal to 22.5 cm, 9% of patients fall in the category of being malnourished, 9% in at risk of malnourishment and 1% were found to be normally nourished. In MAC category of more than 22.5 cm, 8% of patients were malnourished, 31% were at risk of malnourishment and 42% were normally nourished. The research findings were significant ($p<0.0001$) indicating a strong association between MAC and nutritional status. Table no: 33 Figure no: 19.

Mid-Arm Circumference	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
<22.5CM	9	9	1	<0.0001 significant
>22.5CM	8	31	42	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 33 - Mid-arm circumference versus MNA-SF®



MNA-SF® I **MNA-SF® II** **MNA-SF® III**

Figure no. 19- Mid-arm circumference versus MNA-SF®

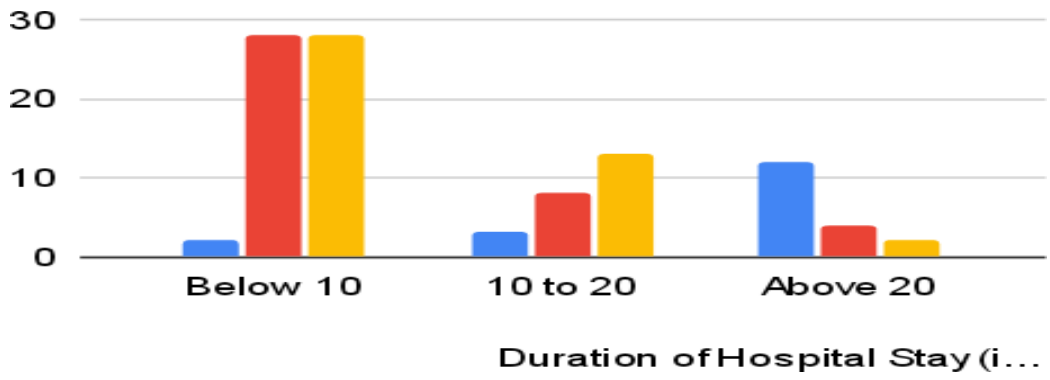
Impact of malnutrition on the duration of hospital stay

In our study, 2% of malnourished patients, 28% of patients at risk of malnourishment, and 28% of patients who were found to be normally nourished had a less than ten days stay in the hospital. 3% of malnourished patients, 8% of patients at risk of malnourishment, and 13% of patients who were found to be normally nourished had a stay between 10-20 days. 12% of malnourished patients, 4% of patients at risk of malnourishment, and 2% of normally nourished patients stayed in the hospital for more than 20 days and the findings are strongly significant ($p<0.0001$) indicting that nutritional status has a strong impact on the length of hospital admission and malnutrition results in prolong hospital stay thus increasing the expenditure on healthcare. Table no. 34 and Figure no. 20.

Duration of Hospital Stay (days)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Below 10	2	28	28	<0.0001 significant
10 to 20	3	8	13	
Above 20	12	4	2	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 34- Duration of Hospital Stay versus MNA-SF®



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

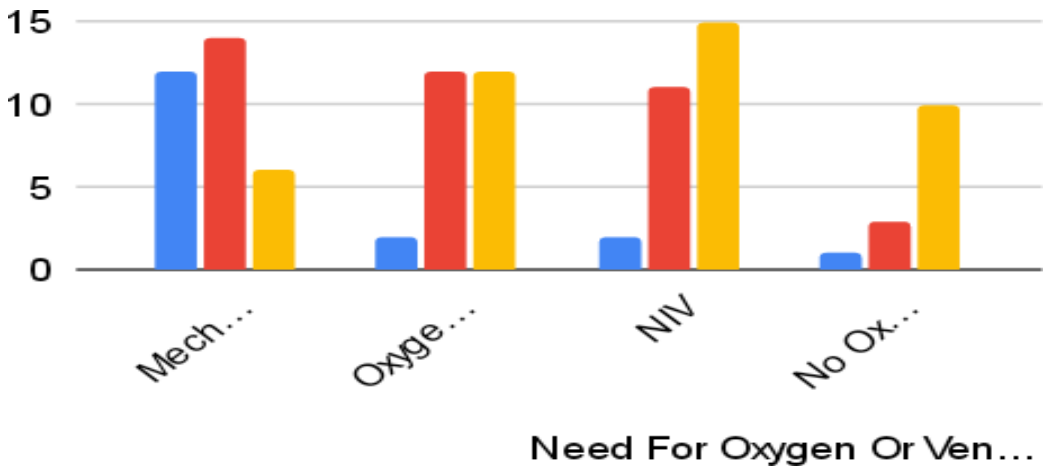
Figure no. 20- Duration of Hospital Stay versus MNA-SF®

Impact of nutritional status on the need of Oxygen or mechanical ventilation

In our study, 12% of malnourished patients, 14% of patients at risk of malnourishment, and 6% of patients who were found to be normally nourished had a need for intubation and mechanical ventilation. 2% of malnourished patients, 12% of patients at risk of malnourishment, and 12% of normally nourished patients required Oxygen via face-mask. 2% of malnourished patients, 11% of patients at risk of malnourishment, and 15% of normally nourished patients were on non-invasive ventilation (NIV). 1% of malnourished patients, 3% of patients at risk of malnourishment, and 10% of normally nourished patients did not require Oxygen, and the results were significant (p-0.0018), thus implying that malnutrition is strongly associated with need for Oxygenation and respiratory support in elderly patients admitted in ICU with respiratory diseases in the present study. Table no. 35 and Figure no. 21.

Need for Oxygen or Ventilation	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Mechanical Ventilation	12	14	6	0.0018 (significant)
Oxygen Via Mask	2	12	12	
NIV	2	11	15	
No Oxygen Requirement	1	3	10	

Table no. 35- Need for Oxygen or Ventilation versus MNA-SF®



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Figure no. 21- Need for Oxygen or Ventilation versus MNA-SF®

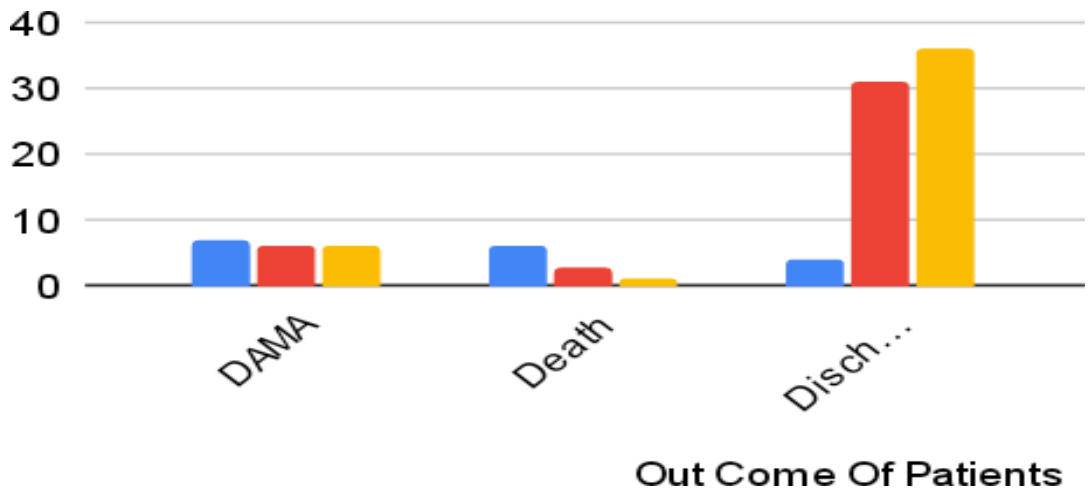
Patient out-come versus nutritional status

In discharged against medical advice (DAMA) category, 6% of patient were malnourished, 6% at risk of malnourishment and 6% were normal nutritional status. 6% of patient who were malnourished, 3% at risk of malnourishment and 1% of patient with normal nutritional status died in ICU. Whereas, 6% of patient who were malnourished, 3% at risk of malnourishment and 1% of patient with normal nutritional were discharged with follow-up (DFU), and there was a strong association between nutritional status and patient's out-come in the study with p value less than 0.0001. Table no. 36 and Figure no. 22.

Out-come of patients	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
DAMA	7	6	6	<0.0001 significant
Death	6	3	1	
Discharge with Follow-up	4	31	36	

MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Table no. 36- Patient out-come versus nutritional status



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Figure no. 22- Patient out-come versus nutritional status

Nutritional status and its association with laboratory findings

Patient's haemoglobin level has strong association (p- 0.0088) with nutritional status, where-in haemoglobin of less than 13.0 gm/dL was found in 17% of malnourished patients, 24% of patients who were at risk of malnutrition, and 31% of patients with normal nutrition. Table no. 37 and Figure no. 23.

Haemoglobin level (gm/dl)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Less than 13	17	24	31	0.0088 significant
13 to 17	0	16	12	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 37- Impact of nutrition on Haemoglobin level

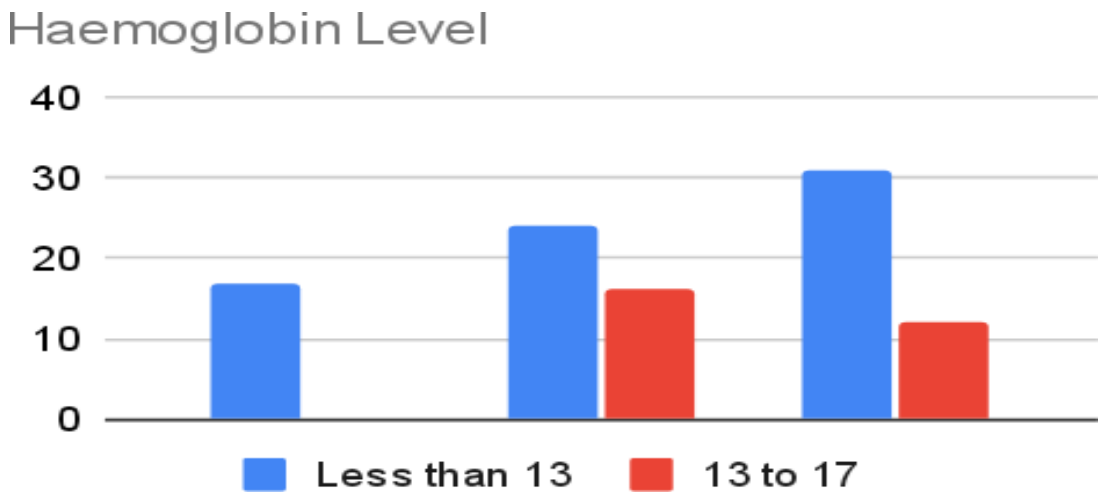


Figure no. 23- Impact of nutrition on Haemoglobin level

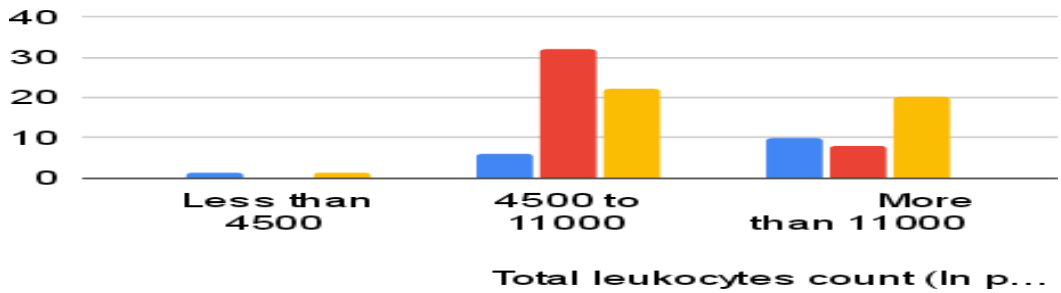
Impact of nutrition on Total leukocytes count (TLC)

Total leukocytes count (TLC) of more than 11,000 per cubic millimetre was strongly associated with malnourishment (p-0.0102) as in this category, 10% of patients were

malnourished, 8% at risk of malnourishment and 20% were normally nourished. Table no. 38 and Figure no. 24.

Total leukocytes count (Cu mm)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Less than 4500	1	0	1	0.0102 significant
4500 to 11000	6	32	22	
More than 11000	10	8	20	

Table no. 38- Impact of nutrition on Total leukocytes count



MNA-SF® I	MNA-SF® II	MNA-SF® III
Blue	Red	Yellow

Figure no. 24- Impact of nutrition on Total leukocytes count

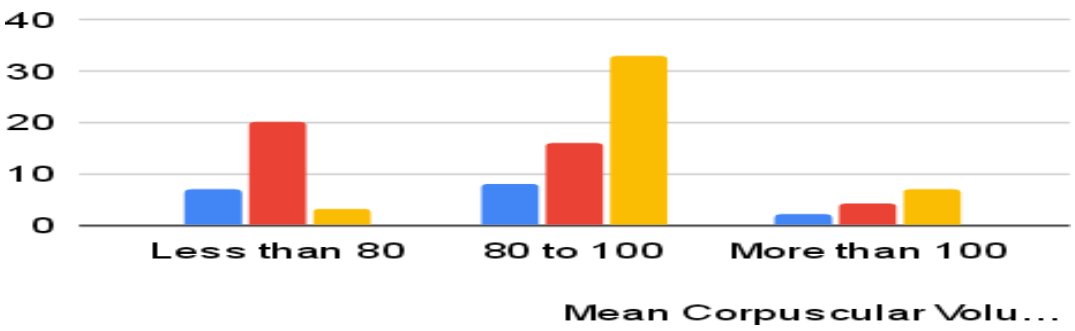
Impact of nutrition on mean corpuscular volume (MCV)

Mean corpuscular volume (MCV) of less than 80fL was found in 7% of malnourished older adults, 20% of elderly who were at risk of malnutrition, and 3% in patients with normal nutrition. MCV of more than 100 fL was found in 2% of malnourished older adults, 4% of elderly who were at risk of malnutrition, and 7% in patients with normal nutrition. This association was found to be significant (p-0.0006). Table no. 39 and Figure no. 25.

Mean Corpuscular Volume (fL)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Less than 80	7	20	3	0.0006 significant
80 to 100	8	16	33	
More than 100	2	4	7	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 39- Impact of nutrition on mean corpuscular volume



MNA-SF® I	MNA-SF® II	MNA-SF® III
Blue	Red	Yellow

Figure no. 25- Impact of nutrition on mean corpuscular volume

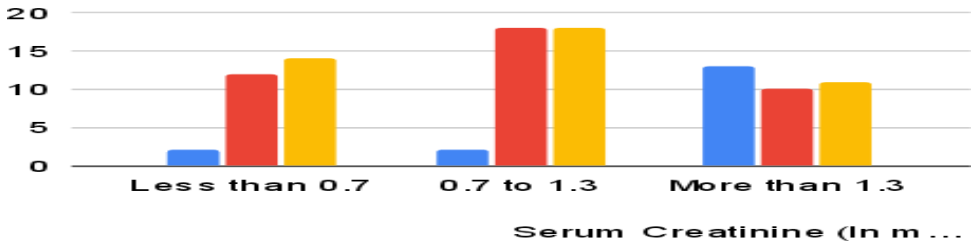
Nutrition levels versus serum Creatinine

Serum Creatinine of more than1.3mg/dL signifies impaired renal function and was seen in 13% of malnourished older adults, 10% of elderly who were at risk of malnutrition, and 11% in patients with normal nutrition. This association was found to be significant (p-0.0023). Table no. 40 and Figure no. 26.

Serum Creatinine (mg/dL)	MNA-SF® I	MNA-SF® II	MNA-SF® III	p-value
Less than 0.7	2	12	14	0.0023 significant
0.7 to 1.3	2	18	18	
More than 1.3	13	10	11	

MNA-SF® I: Score 0-7- Malnourished
MNA-SF® II: Score 8-11- At risk of malnutrition
MNA-SF® III: Score 12-14- Normal nutrition

Table no. 40 - Nutrition levels versus serum Creatinine



MNA-SF® I: Score 0-7- Malnourished-Blue
MNA-SF® II: Score 8-11- At risk of malnutrition-Red
MNA-SF® III: Score 12-14- Normal nutrition-Yellow

Figure no. 26- Nutrition levels versus serum Creatinine

Impact of co-morbidities on various patients' parameters

A maximum of six co-morbidities are seen in the patient population and have significant impact on duration of hospital stay, haemoglobin levels, mid-arm circumference (MAC), and MNA-SF® score. The results show that elderly patients with three co-morbidities stayed longest in the hospital (p-0.0025). Patients with three co-morbidities showed the maximum muscle loss with MAC of ≤ 22.5 cm indicating malnutrition (p-0.0186). 14 patients with 3 co-morbidities were found to be malnourished; and 16 patients with 3 co-morbidities were found to be at risk of malnutrition (p-0.0035). 31 patients with 3 co-morbidities were found to have haemoglobin of <13g/dL (p-0.0329); and 21 patients with 3 co-morbidities were found to have serum Creatinine of > 1.3mg/dL (p-0.0358).The results are statistically significant and are expressed in Table no. 41.

Parameters	Number of co-morbidities						p-value
	0	1	2	3	4	5	
Duration of hospital stay							0.0025 (S)
Below 10 days	03	17	21	06	01	00	
10-20 days	02	08	02	08	02	02	
Above 20 days	00	01	04	13	00	00	
Mid-arm circumference							
≤ 22.5 cm	00	01	04	13	00	01	0.0186 (S)
>22.5 cm	05	25	23	24	03	01	
MNA-SF® score							
0-7	00	01	02	14	00	00	0.0035 (S)
8-11	03	08	10	16	02	01	
12-14	02	17	15	07	01	01	
Haemoglobin level (g/dL)							
Less than 13	01	17	18	31	03	02	0.0329 (S)
13-17	04	09	09	06	00	00	
Serum Creatinine							
Less than 0.7	01	10	09	06	02	00	0.0358 (S)
0.7-1.3	02	12	13	10	00	01	
More than 1.3	02	04	05	21	01	01	

Table no. 41-Impact of co-morbidities on various patients' parameters

Impact of Diagnosis on various patients' parameters

The study population of the present study showed diverse diagnosis all related to various respiratory pathologies. Patients with lower respiratory tract infection were found to be largely malnourished and also at risk of malnutrition; maximum percent of patient with the diagnosis of acute exacerbation of COPD were normally nourished (p-<0.0001). Patients with lower respiratory tract infection were found to be with MAC of ≤ 22.5 cm; 37 patients with the diagnosis of acute exacerbation of COPD were normally nourished with MAC of > 22.5 cm (p-<0.0023). Haemoglobin level of less than 13 g/dL was found in 23 patients with diagnosis of acute exacerbation of COPD, 30 patients with the diagnosis of lower respiratory tract infection, and 12 patients with diagnosis of Cor-pulmonale (p-< 0.0001). The findings were statistically significant and the expressed in table no. 42.

Parameters	Diagnosis						p-value
	I	II	III	IV	V	VI	
MNA-SF® score							
0-7	03	08	01	04	00	01	<0.0001 (S)
8-11	09	14	05	01	04	07	
12-14	25	11	06	00	01	00	
Mid-arm circumference							
≤ 22.5 cm	00	09	05	02	00	03	0.0023 (S)
>22.5 cm	37	24	07	03	05	05	
Haemoglobin level (g/dL)							
Less than 13	23	30	12	05	00	02	<0.0001 (S)
13-17	14	03	00	00	05	06	

Main diagnosis I- Acute exacerbation of COPD
Main diagnosis II-Lower respiratory tract infection
Main diagnosis III-Cor-pulmonale
Main diagnosis IV-ARDS
Main diagnosis V-Bronchial asthma
Main diagnosis V I- Miscellaneous

Table no. 42- Impact of Diagnosis on various patients' parameters

Impact of presenting complaint on various patients' parameters

Breathlessness was the presenting complaint of 11% of the malnourished patients, 29% of the patients who were at risk of malnutrition and 19% of normally nourished elderly patients. These findings were statistically significant with p value of 0.0045. Whereas 16% of patients with breathlessness suffered loss of muscle mass with MAC value ≤ 22.5 cm, 43% of these patients have MAC value > 22.5 cm. Cough with expectoration was the presenting complaint of 22% of patients with MAC 0f > 22.5 cm (p-0.0128). Haemoglobin level was found to be less than13g/dL in 49% of the study population and only 10% of patients had normal haemoglobin level. The findings were statistically significant with p value of 0.0085. The findings implied that breathlessness has association with malnutrition, Lower MAC values and low haemoglobin levels. The results are tabulated in table no. 43.

Parameters	Presenting complaint						p-value
	I	II	III	IV	V	VI	
MNA-SF® score							
0-7	11	02	01	02	01	00	0.0045 (S)
8-11	29	02	05	02	01	01	
12-14	19	18	06	00	00	00	
Mid-arm circumference							
≤ 22.5 cm	16	00	00	02	01	00	0.0128 (S)
>22.5 cm	43	22	12	02	01	01	
Haemoglobin level (g/dL)							
Less than 13	49	13	05	04	01	00	0.0085 (S)
13-17	10	09	07	00	01	01	

Presenting complaint I- Breathlessness
Presenting complaint II- Cough with expectoration
Presenting complaint III- Fever with body ache
Presenting complaint IV- Loss of appetite
Presenting complaint V- Generalized weakness
Presenting complaint VI- Miscellaneous complaints

Table no. 43- Impact of presenting complaint on MNA-SF® score

Discussion

Our study evaluated and assessed the nutritional status and its impact on outcome among elderly patients admitted with respiratory diseases in critical care unit of a tertiary care hospital at Vijayapura. In our study we have found that 17% of older adults admitted in ICU with respiratory diseases are malnourished with low MNA-SF® score in the range of 0 to 7 whereas, 40% of the patients were found to be at risk of malnutrition with intermediate score of 8-11, and 43% patients were found to have normal nutritional status with MNA-SF® score ranging from 12 to 14.

As there is high prevalence of malnutrition in elderly hospitalized patients, so is the ‑risk of malnutrition‖ among elderly patient population. Several studies in the past have concluded that the prevalence of malnutrition in hospitalized geriatric population ranges from 6.6% to 85%, depending upon the method used for diagnosis. Some other studies have estimated that about 30-50% of critically ill patients may have clinical evidence of malnutrition[2].

In a first large scale, cross-sectional, multi-centric study in Belgium conducted by Katrien Vandervee et al[121], found that 33% of hospitalized patients were malnourished. These prevalence figures were consistent with recent European prevalence figures in elderly hospital patients. In annual national Dutch survey, the prevalence of malnutrition was found to be 32.9%[121].

Various studies from the different parts of the globe showed prevalence of malnutrition ranges from 13% to 54%[122]. Whereas findings of some of the Indian studies reported the prevalence of malnutrition in Allahabad to be 25%, in West Bengal it was 29.4% and in Haryana it was 53.4%[122].

Our research findings are comparable with the findings of Yuvaraj Krishnamoorthy et al[122], a study done in rural Puducherry and reported that 17.9% of elderly in their study were malnourished. Our study reported similar findings in which 17% of the elderly hospitalized patients were found to be malnourished.

Lower prevalence of malnutrition in our study and Puducherry study, in comparison to other global and Indian studies can be attributed to the type of method used in screening and evaluation of malnutrition. While in our study, we employed MNA-SF® , which

comprehensively covers dietary, weight loss, Psychological, Neuro-Psychological and anthropometric parameters to screen nutritional status, while other studies used only anthropometric measurements, which might have over-estimated the burden of malnutrition in their study findings.

We found 40% of our study population is at risk of malnutrition. Study conducted by Katrien Vandervee et al[121], in Belgium reported that 43% of elderly patients in their study were at risk of malnutrition. Yuvaraj Krishnamoorthy et al[122], reported that about 58.7% of study population was at the risk of malnourishment, whereas we reported that 40% of our study population was at risk of malnutrition. The reason for this difference in at risk of malnutrition population between our and Puducherry could be that ours is a tertiary care hospital which is largest in the district and is totally private. So that only well to do patients belonging to upper strata of the society can afford to come to our hospital hence, we reported a lower percentage of study population to at risk of malnutrition.

Katrien Vandervee et al[121]concluded that in Belgium, four out of five elderly patients were at risk of malnutrition or suffered malnutrition and only 24% of elderly were found to be well nourished. Results of our study are not consistent with the Belgium study with 43% of patients in our study were with normal nutritional status. The reason for this difference could be same as explained in the previous paragraph above.

Similar to the findings of study done by Chandrashish Chakravarty et al[124], in our study, male patients out-numbered female patients with malnutrition and also out-numbered at risk of malnutrition. The findings of our study are in contrast with the study by Yuvaraj Krishnamoorthy et al[122], in which malnutrition was higher in elderly females. However, this difference in our study was not statistically significant.

The present study found an association between malnutrition and respiratory diseases and malnutrition is associated with significant mortality. These findings are supported by previous published studies which reported an association between cardiovascular mortality and malnutrition and a low BMI is associated with respiratory disease mortality, cancer mortality and cardiovascular mortality.

Respiratory conditions like COPD, Pneumonia and Lung cancer may reduce the appetite and have negative influence on the nutritional intake. There are several studies that revealed an association between respiratory diseases and malnutrition[2,17]. In Dutch

annual prevalence study, it was reported that COPD was independently associated with malnutrition. Higher prevalence of malnutrition and risk of malnutrition in ours as well as most of other studies, emphasize the importance of frequent assessment of the nutritional status among elderly patient population admitted in ICU[123].

In our study we concluded that there is no association between the nutritional status of the patients and their age, gender, diet and appetite. The study by Chandrashish Chakravarty et al[124], reported that gender was not an influential factor among malnourished patients which is a similar finding as our study. Also, Chandrashish Chakravarty et al[124] reported that malnourished patients have higher complication rates, including infections and organ failure, slower recovery and higher rates of psychological difficulties. These findings were similar to our findings in which we reported that malnourished patients have significantly higher duration of hospital stay with significantly higher mortality. Katrien Vandervee et al[121] in their study reported that there is established association between respiratory diseases and malnutrition. Similar findings were reported by Janice Sorensen et al[125] in their EuroOOPS which concluded that 48%-57% of the geriatric population in western Europe are ‒at risk of malnutrition‖. Also, the EuroOOPS[125] study showed that nutritional risk is associated with poor clinical out-come as was found in our present study.

In comparison to normally nourished elderly patients, malnourished older patients are at higher risk of mortality and longer duration of hospital stay. Liu et al[126] reported that there is high prevalence (46.19%) of malnutrition in china as compared to global prevalence, which can be attributed to the socio-economic conditions prevailing and ever rising elderly population which has become a challenge for the Chinese government to manage.

Liu et al[126] and Söderström et al[127] reported that malnourished older adults and those that are at risk of malnutrition have a constantly higher risk of death as compared to normally nourished elderly patients, regardless of the cause of death. Both the studies reported that the mortality data remains significant after controlling for demographic characters of the study population, presenting complaint, co-morbidities, and final diagnosis. Their study concluded that malnutrition can predict preterm death. Liu et al[126] reported mortality of 10.29% (OR 5.738, 95% CI 3.473-9.48) in their study and longer average duration of hospitalization of 12.58±9.25 days (OR 0.2807, 95% CI 0.0294-0.5320). We have

reported similar findings in our study. There is 10% overall mortality in our study with 12% of malnourished patients stayed for more than 20 days. Both these findings in our study were statistically significant with p value of < 0.0001 respectively. Another study done in Singapore reported that 29% of the malnourished had a longer hospital stay of 6.9±7.3 days (p-<0.0001).

Söderström et al[127] reported in the study that there is higher risk of mortality in elderly patients due to prevailing malnutrition with respiratory system diseases with hazardous ratio of 2.19 versus hazardous ratio of 1.49 in elderly patients at risk of malnutrition with respiratory diseases. In line with these findings, we reported mortality of 6% in malnourished group versus only 3% deaths in at risk of malnutrition patients with respiratory disorders.

Considering the causes of mortality in elderly patients with respiratory diseases, Söderström et al[127] reported in their study that among malnourished patients, 7.2% died due to Pneumonia, 9.0% died due to COPD, and reported 12% deaths due to diseases of respiratory system, excluding Pneumonia and COPD. In our study, in malnourished patients, we reported 11% deaths in patients presented with breathlessness, 7% deaths in malnourished patients with 3 co-morbidities, and total of 6% deaths due to COPD and lower respiratory tract infections.

Considering the haematological and biochemical parameters of our study, 72% elderly had haemoglobin less than 13 g/dL, total leukocytes counts were more than 11,000 per cu mm in 38%, mean corpuscular volume was less than 80 fL in 30% and more than 100 fL 13%. Serum Creatinine was more than 1.3 mg/dL in 34% of patients. Liu et al[126] reported that hemoglobin level was associated with longer length of stay, mortality, and 90 days re-admission in their study. Results of our study are in line with current literature that low hemoglobin is responsible for adverse clinical outcome among older adults.

Liu et al[126] suggested that MNA-SF® may be used in combination with hemoglobin level to predict clinical outcome in hospitalized older patients. In our view it is possible but needs further research to establish evidence based findings in this direction. We found that MAC, hemoglobin, leukocyte counts, MCV, and serum Creatinine to be predictor of malnutrition and mortality in elderly patients admitted to ICU with respiratory diseases.

Limitations of the study

The present study is the first attempt to evaluate prevalence of malnutrition risk and its impact on the outcome of elderly ICU patients. One limitation is that the study was conducted in a single center with small numbers of elderly patients. As our hospital is a biggest private tertiary center in the district, catering to the elite and well to do patients and also the ICU receives referral of complicated medical cases with high level of severity. As a result these research findings cannot be generalized to large elderly patient population of the area.

Future directions in the field of nutritional research

The *International classification of diseases, 11th revision* (ICD-11), currently lacks a relevant diagnostic code for malnutrition in older adults, and we hope that this category will be included in the classification, in the future publications.

Considering the growing numbers of older people in the population and the high prevalence of malnutrition, it is imperative to understand the humanitarian and the societal cost of malnutrition. In the future, increased knowledge of the harmful effects of malnutrition and unmet nutritional needs of patients may create a global awareness to consider ‑Clinical Nutrition‖ as human rights, and will be implemented by the governments[114].

Challenges of the complex patient populations, blinding difficulties, lack of consensus on outcome variables, geographical and ethnic differences, inadequate funding and other factors will not deter the future research in this direction.

Considering the magnitude of the problem, we hope that in the future larger, multi-centric, high quality randomized controlled trials according to requirements of Pharmacological trials will be conducted by following cGCP guidelines.

Conclusion

Nutrition is an immensely important area of concern and vulnerability for older adults. Weight loss is the defining feature of frailty. At the same time, obesity is an increasing problem which sometimes persists in old age. Obesity sometimes is associated with Sarcopenia which is an important determinant of metabolic reserve and functional capacity in old people, in acute illness.

Malnutrition is associated with dementia, depression, cancer, cerebro-vascular disease, metabolic disorders, and cardio-respiratory problems. Malnutrition may also be indicative of inadequate and abusive care. During the acute phase of the illness and injury, catabolism predominates and this may lead to weight loss (including muscle loss), which is often not restored with medical recovery.

Many problems add up to decreased food intake in hospital, besides unsuitable and unpalatable food. Poor nutritional intake may result from nil-per-oral status of the patient, loose or painful teeth, dry mouth, lost or ill-fitting denture, nausea, anorexia, dysphagia, change in taste, cognitive problems (forgetting to eat), dyspepsia and constipation.

The main approach to maintaining nutrition in acute hospital care is prevention and treatment of conditions that contribute to poor intake of food. Adequate attention should be given to food preferences and food safety, and provision of sufficient human help for those patients who may need it. Use of special diets must be evaluated in context of the acutely ill person. For instance, high fat food may be better than low fat if they promote palatability, energy intake, and food preferences- especially in patients with COPD.

The findings of our study suggest that malnutrition is highly prevalent in elderly patient population with respiratory diseases admitted in ICU of a tertiary care hospital. Malnutrition results in delayed recovery process with prolonged hospital stay, increases the need for mechanical ventilation, and predispose patient to poor health outcome in comparison with well-nourished patients. It is reported in the study that age, gender, diet, and appetite has no association with the nutritional intake of patients.

Considering the high prevalence of malnutrition and risk of malnutrition as reported in the present study, it is imperative for all patients to be screened for their nutritional status

on admission to the ICU ward and appropriate steps must be taken for further assessment of malnutrition with an objective towards early correction of malnutrition aiming at a favorable clinical outcome. MNA-SF® is a validated screening tool which can be easily employed by any-one of the hospital staff because of its ease of application in a short time to evaluate large number of elderly population.

MNA-SF® in combination of biochemical and hematological parameters like Hemoglobin level, total Leukocyte counts, mean corpuscular volume and serum Creatinine may be used to identify inpatients that are high risk of adverse clinical outcomes and may be a good predictor of patient overall outcome.

An early identification and treatment of malnutrition are important for both elderly patients and health care system. The findings of our study could have major point of consideration for the operational planning of the dedicated elderly ICU, planning for ancillary hospital services, discharge planning and post discharge care of the older adult patients. This strategy should be applied to all hospitals across India as a policy and would presumably decrease the prevalence of malnutrition, thus improving the outcome.

Summary

Malnutrition in elderly adults involves two pathological pathways- they are starvation induced nutritional deprivation, and anorexia caused by inflammation with tissue catabolism- which can be further classified as disease related inflammation with malnutrition, disease related malnutrition without inflammation, and non-disease related malnutrition. In older adults loss of muscle mass cause generalized weakness with Sarcopenia and increases the risk of frailty in older adult. Malnutrition causes increased susceptibility to infection and dysfunction of organ systems.

Prevalence of malnutrition is up-to 10% in community dwelling older people and in 20-50% of hospitalized or institutionalized older people, it was to be 17% in our study. Elderly population admitted in the ICU must be screened for the risk of malnutrition, preferably with in 24-48 hours of admission. MNA-SF is a sensitive and validated tool for the evaluation hospitalized older adults for their nutritional status. Alternatively, recently introduced GLIM approach, which evaluates weight loss, underweight and low muscle mass as phenotypic criteria and decreased food intake with decreased assimilation of food and diseases with inflammation as etiological criteria, can be used to diagnose malnutrition.

Malnutrition should be corrected promptly with nutritional counselling, and oral, enteral or parenteral nutrition as appropriate. Electrolytes, cardiac and respiratory monitoring are essential for preventing re-feeding syndrome. Precision nutrition will allow for personalized treatment. In general, daily energy and protein requirements are 20-30 kcal/Kg/day and 0.8-1.5 gm/Kg/day respectively. Dietary interventions mat still not reverse the condition because of the inflammatory nature of the underlying disease.

Risk factors for malnutrition in older adults admitted in ICU include- loss of muscle mass, low haemoglobin level, raised TLC, and raised serum Creatinine levels. Malnutrition prolongs the stay in hospital and also increases the need for mechanical ventilation with poor patient out-come and mortality. Gender, age, diet and appetite have no association with malnutrition.

Future directions for research includes a refinement of the techniques for detecting malnutrition and a better understanding of anorectic mechanisms and catabolic metabolism in older hospitalized patients

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ANNEXURE- I- Institutional ethical clearance certificate

Azadi Ka Amrit Mahotsav

BLDE

(DEEMED TO BE UNIVERSITY)

Declared as Deemed to be University u/s 3 of UGC Act, 1956

Accredited with 'A' Grade by NAAC (Cycle-2)

The Constituent College

SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 690/2022-23 30/8/2022

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Friday, 26th August, 2022 at 3.30 p.m. in the Department of Pharmacology** scrutinizes the Synopsis of Post Graduate Student of BLDE (DU)'s Shri B.M.Patil Medical College Hospital & Research Centre from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "ASSESSMENT OF NUTRITIONAL STATUS AND ITS IMPACT ON OUTCOME IN ELDERLY ADMITTED WITH RESPIRATORY DISEASES IN CRITICAL CARE UNIT".

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR. SANDEEP KUMAR.

NAME OF THE GUIDE: DR. RAJEEV MALIPATIL, PROFESSOR & HOD
DEPARTMENT OF GERIATRIC MEDICINE

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA

MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103. Karnataka

Following documents were placed before Ethical Committee for Scrutinization

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.
BLDE (DU): Phone: +918352-262770, Fax: +918352-263303, Website: www.bldedu.ac.in, E-mail:office@bldedu.ac.in
College: Phone: +918352-262770, Fax: +918352-263019, E-mail: bmpmc.principal@bldedu.ac.in

ANNEXURE- II

Major screening, assessment and diagnostic tools for malnutrition in older adults[2]

Tool	Weight loss	Appe-tite loss	BMI	Low muscle mass	Low food intake	Infla mma-tion
Screening for malnutrition						
MST (1999)	>1Kg	Yes	-	-	-	-
MUST (2000)	>5% in past 6 months	-	<20	-	Yes	Yes
NRS (2002)	>5%	-	<20.5	-	Yes	Yes
SNAQ (2005)	>3Kg in past 1 month or >6Kg in the past 6 months	Yes	-	-	-	-
Assessment and diagnosis						
SGA (1987)	>5% in the past 6 months	Yes	-	Yes	Yes	Yes
Patient cantered SGA (1995)	>2% in the past 1 month	Yes	-	Yes	Yes	Yes
MNA (1999)	>1Kg in past 3 months	Yes	<23	-	Yes	Yes
MNA-SF (2001)	>1Kg in past 3 months	Yes	<23	-	Yes	Yes
Definition of cachexia (2008)	>5% in past 1 year	Yes	<20	Yes	-	Yes
Definition of protein energy wasting (2008)	>5% in past 3 months or >10% in past 6 months	-	<23	Yes	Yes	CKD
Definition of cancer cachexia (2011)	>5% in past 6 months or >2% if low BMI	-	<20	Yes-	-	Cance r
AAIM (2012)	>1-2% in the past week	-	-	Yes	Yes	Yes
ESPN (2015)	>5% in the past <3months or >10% in the past >3 months	-	20/22	Yes	-	-
GLIM (2019)	>5% in the past <6 months or >10% in the past >6 months	-	22/20/ 18.5	Yes	Yes	Yes

AAIM (AND)-Academy of Nutrition Dietetics/ ASPN- American society of Parenteral and Enteral Nutrition/ BMI-Body Mass Index/ CKD- Chronic kidney disease/ ESPN- European society of clinical nutrition and metabolism/ GLIM- Global leadership initiative on malnutrition/ MST- Malnutrition screening tool/ MUST- Malnutrition universal screening tool/ NRS- Nutritional risk screening/ SGA- Subjective global assessment/ SNAQ- Short nutrition assessment questionnaire. According to ESPN & GLIM- the BMI cut-off 22 for > 70 years old & 20 for person < 70 years of age. GLIM for Asian population- < 20 for > 70 years old & < 18.5 for person < 70 years of age.

ANNEXURE- III- Mini nutritional assessment –short form registered with Nestle

Mini Nutritional Assessment

MNA®

Nestlé Nutrition Institute

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake ☐

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out ☐

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no ☐

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F1 Body Mass Index (BMI) (weight in kg) / (height in m)^2 ☐
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2. DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 Calf circumference (CC) in cm
0 = CC less than 31
3 = CC 31 or greater ☐

Screening score ☐☐
(max. 14 points)

12-14 points: ☐ Normal nutritional status
8-11 points: ☐ At risk of malnutrition
0-7 points: ☐ Malnourished

Save Print Reset

ANNEXURE- IV

Proforma

–Assessment of nutritional status and its impact on outcome in elderly admitted with respiratory diseases in critical care unit‖

1.Patient's name	**2.Age & Gender**	**3. I.P.No.**	**4. DOA**	**5.DOD & length of stay**
6.Presenting Complaint				
7. Pathology & Biochemistry findings				
8. Radiological Findings				
9. ECG & 2D Echo Findings				
10. Diagnosis				
11.Built of Patient	**12.Appearance**	**13.Weight**	**14.Height**	**15.Mid arm circumference**
16.Clinical Outcome			**17. Ventilator/ NIV Support**	
MNA-A.Food intake decreased past 3 months	**0= severe decrease in food intake**	**1= Moderate Decrease in food intake**	**2= No decrease in food intake**	
MNA-B.Weight loss during last 3 months	**0=Weight loss > 3 kg**	**1= Don't know**	**2= weight loss between 1- 3 Kg**	**3= no weight loss**
MNA-C. Mobility	**0= bound to bed or chair**	**1=Get out of bed or chair but don't move**	**2= moves out**	
MNA-D. Psychological stress or acute disease past 3 months	**0= Yes**	**2= NO**		
MNA-E. Neuro-psychological Problem	**0= severe dementia or depression**	**1= mild dementia**	**2= no Neuropsychological problem**	
MNA-F. BMI	**0=< 19**	**1=19-<21**	**2= 21-< 23**	**3 = > 23**
MNA-G. calf circumference cm	**0=< 31 cm**	**3=> 31 cm**		
MNA-SS Screening score	**12-14 normal nutritional**	**8-11 At risk of malnutrition**	**0-7 Malnourished**	
18.Caregiver's Name	**19.Caregiver's age**	**20.Caregiver's Occupation**	**21.Relation with patient**	**22.Caregiver's contact No.**

ANNEXURE- V

Research work done by Dr. Sandeep Kumar, 21BMGRE01

Consent Fort

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I confirm that..... (Name of the PG guide / chief researcher) has explained to me the research, the study procedures that I undergo and the possible risks and discomforts as well as benefits that I may experience. I have read and I understand this consent form. Therefore, I agree to give my consent for my participation as a subject in this research project.

Participant / guardian	Date
Witness to signature	Date

ANNEXURE VI

Master Chart

SL No.	NAME	AGE	G	IP NO	DOA	DOD	OUTCOME	OUT COME	DAYS	PC1	PC2	PC3	PC4	DI	D1	D2	D3	D4	VENTILATOR/NIV	MAC	DIET	APPETITE	HABBITS	MNA SCORE	Hb	MCV	TLC	PLT	S.CREAT	S.URIC ACID	TOATL BIL	CRP	S.Ca	S.ALB	SGOT	SGPT	HBA1C	D DIMER	TROPI	S.K	S.Na	NT PRO BNP
1	SIDDAYYA R MATH	75	M	339951	28.09.22	6.10.22	DFU	3	9	BREATHLESNESS	SWEATING	NAUSEAS& VOMMITING		III	PUL EDEMA	IHD	ANAEMIA	TYPE 2 DM	NO	26	MIXED	RED		13	11.6	73.8	24.6	279	1.3	11		-		-	134	244		2423.99	3281.8	3.5	130	_
2	MANTAPPA JAWALGI	60	M	341265	28.09.22	7.10.22	DFU	3	11	COUGH WITH SPUTUM	BREATHLESNESS			VI	COPD	IHD	ATRIAL FIBRILATION	CVA,PNEMONIA,PAH	V	18.5	MIXED	RED	SMOKER	10	11.2	86.2	11.1	173	0.9		2.2	-	_	3.8	207	218	_	_	23.7	_		9622
3	SHARANAPPA ASANGI	74	M	294639	29.09.22	14.10.22	DFU	3	16	WEAKNESS	SLURRING OF SPEECH			V	BrA,	HTN,IHD	THALAMIC BLEED		NO	23.5	MIXED	N	SMOKER	11	12.1	80.8	11.3	253	1.4	8.2	-			4.3	18	12						
4	SOMALABAI	70	F	291276	11.10.22	16.10.22	DAMA	1	6	BREATHLESNESS	COUGH WITH EXPECTORATION	DIFFCULTY SPEAKING	PAIN ABDOMEN	V	BrA,	T2DM	PAH	EMBOLISM	M	23	MIXED	RED		8	13.5	92.8	11.2	263	0.6		-	-		-	-	-65	8	2306.66				
5	GANGABAI	70	F	348940	4.10.22	4.10.22	DEATH	2	1	BREATHLESNESS	FEVER	FACIAL EDEMA		II	PNEUMONIA	COPD	COR PULMONALE	ATRIAL FIBRILATION	NIV	21	VEG	N		8	13.3	88.5	16.3	105	0.8				6.9					7314.39				
6	MALLAYYA SANGAYYA	60	M	354839	9.10.22	15.10.22	DFU	3	7	BREATHLESNESS	COUGH W/O EXPECTORATION	FEVER		VI	COR PULMONALE	ATRIAL FIBRILATION	IHD		M	27	VEG	RED		9	14	86.7	13	205	1	8	0.8	90	8.3	3	97	93			12.3			
7	ANNAPURNA ASHOK	62	F	346343	2.10.22	22.10.22	DEATH	2	17	LOOSE STOOL	LOWER LIMB WEAKNESS B/L			I	COPD	OLD TB	GBS	QUADRIPLAGIA	V	48	VEG	N	-	6	12	102.8	12	200	3.6									10000	6813.7			
8	SUSALABAI BIRADAR	66	F	146308	9.10.22	20.10.22	DFU	3	12	BREATHLESNESS	COUGHT WITH EXPECTORATION	FEVER		III	COPD	PAH	RESPIRATORY ACIDOSIS		NIV	22	MIXED	RED	-	8	11.9	79.5	12.1	318	0.6	4.5			8.9							4.7	131	
9	GIRIJA BAI WALIKAR	85	F	307135	27.09.23	04.10.23	DEATH	2	8	BREATHLESNESS	COUGH WITH EXPECTORATION	FEVER	B/L LL SWELLINGH	VI	COPD	COR PULMONALE	AKI	IHD	NIV	22	VEG	N	-	6	11.5	71.7	20.6	58	3.2	9.9	1.6	45	6.4	3.1				1814	17.9	3.5	142	
10	YALLAWA RAGATE	70	F	337163	25.9.22	13.10.22	DAMA	1	19	BREATHLESNESS	CHEST PAIN			III	PUL EDEMA	T2DM	HTN	CKD,IHD, LVF	V	28	VEG	RED	-	12	8	92.4	20.3	212	3.8	13.6			8							3.4	111	
11	POMU LAMANI	60	M	305514	1.9.22	29.9.22	DFU	3	29	BREATHLESNESS	COUGH WITH EXPECTORATION	CHEST PAIN		V	LRTI	ABPA	BrA		V	28	MIXED	N	SMOKER	12	13.2	81.599	11.3	466	0.9	2.4			7.9	2.8	43	34	7.4					
12	KASTURIBAI YANAKMHI	60	F	305276	1.9.22	7.9.22	DFU	3	7	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	TB SEQUALAE	IHD	T2DM	MASK	29	MIXED	N	-	12	11.4	108.8	14.3	288	2	8.8	0.4		8.6				8		2.4	5.2	132	
13	GAURABAI DUNDAPPA	65	F	317936	10.9.22	15.9.22	DFU	3	6	BREATHLESNESS	DRY COUGH	FEVER	LOSS OF APPETITE	I	COPD	T2DM	HTN	DISELECTROLYTEMIA	V	36	MIXED	RED	-	13	13.8	82.5	10.5	345	0.5	3.7	0.5	46.1	8.5	4.7	30	15	8.2	484.31	11.3			1750
14	GUJU KESHU JADHAV	60	M	317924	10.9.22	13.9.22	DFU	3	4	BREATHLESNESS	BREATHLESNESS			I	COPD				NIV	32	MIXED	N		14	15.7	87	8.4	261	1.8													
15	KONDIBA MURTHY	75	M	319653	12.9.22	14.9.22	DAMA	1	3	BREATHLESNESS	BREATHLESNESS			I	COPD	SEVERE ANAEMIA	DIC		V	38	MIXED	RED	-	14	4.4	80	24.9	54	1.6	11.6			8.5					10000			130	
16	BHORAMMA PUJARI	68	F	320319	12.9.22	22.9.22	DFU	3	11	FEVER	BREATHLESNESS	COUGH		II	PNEUMONIA	T2DM	HTN	RETINOPATHY	NIV	34	VEG	N	-	13	8.8	63.1	10.5	477	0.7											4.3	134	
17	VITABAI MEITRI	70	F	323229	18.9.22	23.9.22	DFU	3	6	COUGH WITH SPUTUM	BREATHLESNESS	GIDDINESS	PAIN ABDOMEN	II	VIRAL PNEUMONIA	HTN	PARAUMBILICAL HERNIA		V	34	VEG	RED	-	14	12	102.8	8.9	406	0.7	3.1			8.4	3.4	20	20		345.33				
18	MOTILAL RATHOD	76	M	325940	16.9.22	22.9.22	DFU	3	7	BREATHLESNESS	BREATHLESNESS			II	LRTI	IHD	HTN		NIV	34	MIXED	RED	-	14	9.6	84.8	7.2	196	0.7					3.4	20	20				3.8	136	
19	HAWABEE HUSENSAB	75	F	328104	18.9.22	20.9.22	DAMA	1	3	BREATHLESNESS	VOMITING	GIDDINESS	PAIN ABDOMEN	I	COPD	IHD	GASTRITIS		MASK	34	MIXED	RED		14	12	72.8	19.2	291	1.4	5.8	1.3		8.2	3	42	36	6.9			2.7	127	
20	KAMALABAI BASAPPA	79	F	359944	13.10.22	20.10.22	DFU	3	8	FEVER	BREATHLESNESS	PEDAL EDEMA	COUGH	V	PNEUMONIA	CCF			MASK	48	VEG	N	-	10	12.3	96.8	6.3	193	0.8	3.6	0.7		7.8		29	29			14.6			1852
21	BASANNA GOUDA	65	M	360395	13.10.22	22.10.22	DFU	3	10	BREATHLESNESS	COUGH WITH EXPECTORATION			V	PULMONARY TB				MASK	23	MIXED	N	SMOKER AND ALCOHOLIC	8	15.5	82.8	12.1	251	1.5	8.4		90	8.6	2.8	30	61			25			
22	RATANAVA KAMBI	62	F	360120	13.10.22	18.10.22	DFU	3	6	BREATHLESNESS	COUGH WITH EXPECTORATION	SWEATING		II	PNEUMONIA	DKA	T2DM		V	27	VEG	N	-	11	12.2	75.599	27.2	319	0.7						18	19	10.9		163.3			
23	HYDERALI	75	M	330886	21.9.22	30.9.22	DFU	3	10	BREATHLESNESS	FEVER			I	COPD				V	34	MIXED	N	-	14	15	81.599	12.6	548	1.1	3.6	0.4		8.3		28	26	6.2	284.42			134	950
24	PARAMMA SHANKAR	60	F	332187	21.9.22	3.10.22	DFU	3	13	BREATHLESNESS	COUGH WITH EXPECTORATION	FEVER		IV	ILD	LRTI	T2DM	TB,IHD	V	28	MIXED	RED	TOBBACO CHEWER	10	10.9	75.2	13.3	266	0.5	5.2	0.7	87.1	9.8	3.6			8.6	1648.75				
25	RAMAPPA KAMBLE	75	M	332885	22.9.22	1.10.22	DAMA	1	10	BREATHLESNESS	BACKACHE RAD TO L/L			VI	RIGHT PLEURAL EFFUS	METASTATIC COMP OF L4			NIV	24	VEG	N	-	9	13.3	77.8	10.2	159	0.8	5.4	1.5		8.1	2.9	23	68						
26	DEVAVVA LAMANI	70	F	308351	28.9.23	29.9.23	DAMA	1	2	BREATHLESNESS	BREATHLESNESS			VI	COR PULMONALE	HTN	CCF		V	23	VEG	N		11	10.2	106.2	13.1	192	3.8					3.2						3.3	144	
27	PADEPPA SONAND	62	M	342514	29.9.22	30.9.22	DAMA	1	2	WEAKNESS	LOSS OF APPETITE	L/L SWELLING	ABD DISTENSION	II	ARDS	PNEUMONIA	HCV+	T2DM	MASK	36	MIXED	RED	SMOKER AND ALCOHOLIC	14	11.9	81	14.4	78	0.7	4.5	0.7			2.3	28	58	13.3					1266
28	DONDAPPA GURASIDD	65	M	342703	29.9.22	1.10.22	DAMA	1	3	COUGH WITH SPUTUM	BREATHLESNESS	L/L SWELLING		I	COPD	ANAEMIA			V	28	VEG	RED	SMOKER AND GANJA	14	4.9	124.6	9.5	270	0.7	4.7	2.7	43.7	8.3	3.4	24	20	4.5					
29	RAMACHANDRA MISALE	89	M	352811	8.10.22	11.10.22	DFU	3	4	BREATHLESNESS	FEVER			III	PAH	BrA	ATRIAL FIBRILATION		V	28	MIXED	RED	-	13	10.7	85.2	7.6	150	1.4	6.1			8.1						5.9			
30	RAMACHANDRA TUKARAM	65	M	214472	2.7.22	15.7.22	DEATH	2	14	FEVER	COUGH			IV	TYRE 1 RESPFAILURE	TB	MODS	PUL. EMBOLISM	V	20	MIXED	N	SMOKER	7	6.5	78.5	8.4	374	1.4		2.6	90		2.1	39	78		6069	57.7	2.2	132	
31	BHAGIRATHI PATIL	73	F	310174	29.9.23	4.10.23	DFU	3	6	WEAKNESS	BREATHLESNESS	LOWER BACK PAIN		IV	PLEURAL EFFUSION	MI	T2DM	HTN	NO	25	VEG	RED	NIL	5	9.8	61.4	5.3	222	0.8	4.9							8	638.1				
32	GOURAMMA BIRADER	68	F	347141	3.10.22	8.10.22	DFU	3	8	BREATHLESNESS	LOSS OF APPETITE	GENERALIZED WEAKNESS		III	PAH	HTN	ANAEMIA	IHD	NIV	24	VEG	RED	-	11	9.1	77.7	16.1	254	1.5													
33	GANAPATI PATTAR	70	M	348930	4.10.22	8.10.22	DAMA	1	5	BREATHLESNESS	BREATHLESNESS			II	PNEUMONIA	TB	PULFIBROSIS	IHD,AKI	NIV	28	VEG	RED		10	11.2	81.8	24.9	200	3.6	14.8	2.5		7.8		1155	2056	6.2		6654.9			
34	GUDUSAB TIDAGONDI	65	M	349667	5.10.22	11.10.22	DFU	3	7	BREATHLESNESS	BREATHLESNESS			I	COPD	ATRIAL FIBRILATION	DIALTED CARDIOMY		V	32	MIXED	N	SMOKER AND ALCOHOLIC	14	13.5	77.5	11.3	188	1.4											4	136	
35	JUMANNA NAGARBETTA	70	M	362384	15.10.22	22.10.22	DFU	3	8	BREATHLESNESS	DRY COUGH			I	COPD				NIV	25	MIXED	N	-	11	16.4	89.2	15	240	1											4.5	132	
36	AMBANNA BALIRAM	60	M	361508	14.10.22	20.10.22	DFU	3	7	BREATHLESNESS	CHEST PAIN	COUGH WITH SPUTUM		III	COPD	COR PULMONALE	IHD		NIV	21	MIXED	N	-	10	11.9	83.7	5.7	51	1													
37	LAXMIBAI BANYANAVAR	60	F	361593	14.10.22	20.10.22	DFU	3	7	BREATHLESNESS	FEVER	GIDDINESS	LOSS OF APPETITE	I	COPD	LRTI	HTN	T2DM	NIV	27	MIXED	N	-	12	12.9	106.2	11.8	177	0.7								5.6			2.9	137	
38	REVANASIDDA KALLAPA	65	M	353466	8.10.22	18.10.22	DFU	3	11	BREATHLESNESS	COUGH WITH EXPECTORATION	BODY ACHE	NECK PAIN	II	LRTI				MASK	24	MIXED	N	TOBBACO CHEWER	14	12.8	88.4	7	242	0.7	3.5	0.4		9.1	3.8	31	32						
39	KASTURI BAI YANKANHI	60	F	305276	1.9.23	7.9.23	DFU	3	7	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	TB SEQUALAE	T2DM		NIV	26	MIXED	N		13	11.4	82.3	14.3	288	2	8.8	0.4		8.6	4.2	19	17	8		2.4			
40	YADAPPA BAJANTRI	68	M	367391	19.10.22	24.10.22	DFU	3	6	BREATHLESNESS	COUGHT WITH EXPECTORATION	FEVER		I	COPD	EMPHYSEMA			MASK	24	MIXED	N	SMOKER AND ALCOHOLIC	12	16.8	87.7	8.9	221	0.7											4.3	138	
41	RAMACHANDRA MISALE	89	M	352811	8.10.22	11.10.22	DFU	3	4	BREATHLESNESS	FEVER			III	BR ASTHMA	PAH	ATRIAL FIBRILATION		NIV	29	MIXED	RED	-	13	10.7	85.2	7.6	150	1.4	6.1			8.1						5.9			
42	LAXMIBAI MALLAPPA	70	F	366371	18.10.22	21.10.22	DEATH	2	4	BREATHLESNESS	COUGH WITH EXPECTORATION	CHEST PAIN	LOSS OF APPETITE	IV	LUNG METASTASIS	CA TOUNGE			V	18.5	MIXED	N		5	9.6	104.2	42.3	615	0.6		0.7				44	21				4.9	133	
43	SHARARANAPPA BIRADER	60	M	366519	19.10.22	2.11.22	DFU	3	15	BREATHLESNESS	FEVER	COUGH WITH SPUTUM		II	PNEUMONIA	COVID 19			MASK	26	VEG	N		11	13.8	77.3	10.9	284	0.8	6.4	0.7	37.5	9.1	3.5	53	31	6.8	554.64		4.7	130	
44	LACCHAWA GANGAPPA	60	M	366178	18.10.22	24.10.22	DFU	3	7	BREATHLESNESS	COUGH	ORTHOPNEA		III	LVF	IHD	MI	T2DM	NIV	32	VEG	N		12	12	88.8	11.5	126	0.5										2020	5.4	135	
45	RAMKA BAI RATHOD	80	F	371523	22.10.22	24.10.22	DFU	3	3	BREATHLESNESS	BURNING MICTURITION	COUGH WITH SPUTUM		III	PUL EDEMA	HTN EMERGENCY	CCF	T2DM	NIV	21	MIXED	N		9	11.6	82.4	9.6	266	1	6.7		79	8.9	4.4	92	45	6.1	1040	108	4.8	130	
46	BASAPPA SIDDAPPA	75	M	370183	21.10.22	30.10.22	DAMA	1	10	BREATHLESNESS	COUGH WITH EXPECTORATION	L HEMIPLEGIA		II	PNEUMONIA	T2RESPI FAUILURE	CVA-HEMIPLEGIA	PRESSURE ULCERS	V	24	VEG	RED	SMOKER AND ALCOHOLIC	1	8.3	78.8	3.9	189	1.4		0.7		7.6	2.1				3093				
47	J B HUSSAINI	71	F	365405	18.10.22	27.10.22	DFU	3	10	BREATHLESNESS	SWELLING OF B/L FEET	Br ASTHMA	ANAEMIA	III	PUL EDEMA	T2DM	HTN	IHD	MASK	28	MIXED	N		14	11.7	102.8	7.4	170	6.2								8.4		19.7	5	138	
48	KASTURIBAI PUJARI	68	F	374065	25.10.22	30.10.22	DFU	3	6	COUGH WITH SPUTUM	BREATHLESNESS	FEVER	VOMMITING	II	PNEUMONIA	ANAEMIA	SEIZURES	PUL TB	MASK	19	VEG	RED		8	8	71.599	8.1	327	0.3		0.6			2.1					5.5	3.7	128	
49	BASAMMA PARAMANNA	65	F	374842	26.10.22	31.10.22	DFU	3	6	COUGH WITH SPUTUM	CHEST PAIN	BREATHLESSNESS		II	PNEUMONIA	T2DM	DKA	CCF	V	26	MIXED	N	-	7	10.4	80.5	9.1	225	1	10.6	0.7		10.2	3.9	101	67	13.6		117.1			24550
50	SHIVANADA AKKALWADI	63	M	363525	16.10.22	19.10.22	DFU	3	4	BREATHLESNESS	FEVER	COUGH WITH SPUTUM	TB	I	CHRONIC BRONCHITIS	HTN	T2DM	ILD	NIV	29	MIXED	RED	ALCOHOLIC	9	11.6	82.9	17.2	105	0.8					3	23	16			9.2	2.2	130	
51	SUBASH BASVANT KYADI	65	M	377543	28.10.22	31.10.22	DEATH	2	4	FEVER	DRY COUGH	BREATHLESSNESS		VI	PUL EDEMA	T2DM	HTN		V	27	MIXED	N	-	8	14.2	88.6	14.1	153	1.4									5500	122.8	5.3	132	572
52	NEELAPPA BELLARD	65	M	380598	31.10.22	4.11.22	DFU	3	5	FEVER	COUGH WITH EXPECTORATION	BREATHLESSNESS		II	LRTI	PUL EDEMA	COPD		MASK	34	VEG	RED	SMOKER AND TOBBACO	14	12.5	79.5	10.4	345	0.7													
53	YAMANAWWA HANGARAGI	70	F	380366	31.10.22	7.11.22	DFU	3	8	BREATHLESNESS	COUGH WITH EXPECTORATION	FEVER		II	LRTI	PUL TB			V	24	VEG	RED	TOBBACO CHEWER	8	11.8	74.599	26.9	412	0.5													
54	HAJI KABADE	60	M	383991	3.11.22	4.11.22	DEATH	2	2	WEAKNESS	VOMITING			II	PNEUMONIA	THALAMI BLEED	DM	AKI	V	26	MIXED	RED	-	8	14.6	85.6	17.1	273	2.2	10.7		90	6.8				13.5					
55	CHANDERSHEKHAR BASAPPA	70	M	393997	12.11.22	15.11.22	DFU	3	4	COUGH WITH SPUTUM	ABDOMINAL DISCOMFORT	VOMITING		I	COPD	HYPONATREMIA	HTN	CCF	MASK	28	MIXED	N	SMOKER	11	12.8	74.4	15.8	300	0.8													
56	GURUPADAWWA	61	F	268351	15.11.22	27.11.22	DAMA	1	13	COUGH WITH SPUTUM	FEVER	BREATHLESNESS		IV	CA LUNG	PLEURAL EFFUSION	SEIZURES		V	24	MIXED	RED		7	12.1	86.4	9.5	306	0.5											3.6	136	
57	KASTURI BAI PUJARI	65	F	396046	14.11.22	21.11.22	DFU	3	8	BREATHLESNESS	FEVER	COUGH WITH EXPECTORATION		II	PNEUMONIA	PUL TB	PAH	SEPSIS	NIV	21	VEG	N		9	6.8	97.6	22.5	463	0.8			90			11	19		2422		4.2	131	
58	NABISAB JAKATI	71	M	397729	16.11.22	5.12.22	DFU	3	20	COUGH WITH SPUTUM	BREATHLESNESS	FEVER	PAIN ABD	II	PUL TB	IHD	PLEU EFFUSION	HYPOTHYROIDISM	V	24	MIXED	RED	SMOKER	9	10.6	72.2	16.2	349	1.4		1.9			4					4.9	4	135	
59	SABAVVA AMOGEPPA	65	F	398392	16.11.122	28.11.22	DFU	3	13	COUGH WITH SPUTUM	FEVER	ANASARCA	LOSS OF APT	I	COPD	CH. BRONCHITIS	PAH	HTN	NIV	26	MIXED	RED		14	12.4	103.33	12.2	286	1.7	11.1	1.1		6.7	3.7	188	664			2.8		143	2314
60	DOULASAB AEBAR	62	M	403535	21.11.22	22.11.22	DFU	3	2	BREATHLESNESS	COUGH WITH EXPECTORATION	FEVER	LOSS OF APT	II	XDR TB	BRONCHIECTASIS	PLHIV	LUNG FIBROSIS	MASK	21	MIXED	N		5	9.4	78.3	10.4	687	0.4	10	0.3		9.2	2.9	17	11	5.9		4.9		128	
61	SHIVAPPA BOMMANAHALLI	87	M	403765	21.11.22	24.11.22	DAMA	1	4	BREATHLESNESS	FEVER	COUGH WITH EXPECTORATION		II	PUL TB	GTCS			MASK	19	MIXED	RED	SMOKER	6	11	79	29.5	92	0.9		0.5		8.1	2	51	54			4.1		134	
62	SHIVARAYA INDI	86	M	406091	23.11.22	30.11.22	DFU	3	8	COUGH WITH SPUTUM	LOOSE STOOLS			I	COPD	AGE			MASK	29	MIXED	N		14	14.3	93.8	14.7	30	2.3	4.1			7.6						3.5		137	
63	SHANKARAMMA BIJUR	80	F	409886	26.11.22	30.11.22	DFU	3	5	BREATHLESNESS	ANASARCA	ABD DISTENTION		VI	PLEURAL EFFUSION	CCF	T2DM	HTN	MASK	21	MIXED	RED	-	11	13.5	96.4	20	120	1.6													
64	SEETABAI JOSHI	85	F	396065	25.11.22	28.11.22	DFU	3	4	BREATHLESNESS	COUGH WITH EXPECTORATION			II	PNEUMONIA	PAH	PLEU EFFUSION	HTN	NO	25	VEG	N		11	7.5	71.3	11.1	554	0.8	4	0.3		8.8	3.6	16	19		1364.41	8.1			
65	PARVATI MAHADEVAYYA	75	F	407313	24.11.22	29.11.22	DFU	3	6	BREATHLESNESS	FEVER			I	COPD				MASK	24	MIXED	N		11	9.8	117.6	12.4	154	2.4	4.5	3.9		8.5	3.7	27	19	6		4.2		138	3229
66	GURUAPPA GIRAGAVI	72	M	427006	11.12.22	141.12.22	DFU	3	4	BREATHLESNESS	CHEST PAIN	COUGH WITH EXPECTORATION		I	ARDS	HTN	T2DM	ACS	NO	28	MIXED	N		14	12.9	104.8	13.5	276	4.2		1.4			3.9	33	24	10.8	665.87	391			
67	GOVRAMMA	61	F	417978	3.12.22	26.2.22	DFU	3	24	BREATHLESNESS	FEVER	L/L SWELLING	ABD DYSCOMFORT	I	PUL THROMBOEMBOLI	COPD	COR PULMONALE	AKI	V	24	MIXED	N		9	10.4	102.2	7.2	239	2.6	8.5	0.4	12.3	8.5	3.6	223	64		6078	1826			25000
68	SOMANINGA SIDDAPPA	70	M	431723	15.12.22	20.12.22	DAMA	1	6	BREATHLESNESS	RED APPETITE	L/L SWELLING		I	COPD	PUL THROMBOEBOLI	IHD	AKI	MASK	27	MIXED	RED	TOBBACO CHEWER	7	17.9	92.8	8.5	41	2.1	15.9			9.4					10000	336.9			
69	SIDDAMMA SHIVAN GOUDA	65	F	407697	25.11.22	7.01.23	DFU	3	45	BREATHLESNESS	LOSS OF APPETITE	BURNING SENSATION	ABD DYSCOMFORT	I	COPD	PLEURAL EFFUSION	T2DM	T1 RESP FAILURE	V	24	MIXED	RED	-	9	16.2	82.9	12.2	221	0.6	2.7	0.6		8.8	3	23	15	11.1			6.9	137	
70	KASHIRAM SHINDE	76	M	414300	30.11.22	17.12.22	DAMA	1	18	WEAKNESS	BED RIDDEN	WOUND ON LEFT LEG		II	RESP FAILURE	HTN	UROSEPSIS	AKI	NIV	26	MIXED	RED	ALCHOLIC AND SMOKER	7	12.3	77.3	12.8	441	1.6	6.3	0.9		8	3	20	30			1675.9			
71	PAVITRABAI MUTTAPPA	75	F	196798	20.12.22	21.12.22	DFU	3	2	BREATHLESNESS	WEAKNESS			II	PNEUMONIA	BRONCHIECTASIS	IHD		V	28	VEG	RED	-	11	14.5	90.2	11	281	0.9											5.5	137	
72	ADIVEPPA SANGAPPA	92	M	440656	23.12.22	3.1.23	DEATH	2	12	BREATHLESNESS	FEVER	REDUCED APPETITE		I	PAH	COPD	OLD TB	T2 RESP FAILURE	V	23.5	MIXED	RED	-	5	12.7	98.2	11.2	156	2.5	9.8		90	8.6					8350.43	1208			
73	MALLAPPA SANGAPPA	70	M	451848	31.12.22	9.1.23	DFU	3	10	BREATHLESNESS	FEVER	ABD PAIN		II	PNEUMONIA	COPD	T2DM	PUL TB	NIV	36	MIXED	RED	TOBBACO CHEWER, SMOKER	14	11.4	98.4	9.7	396	0.6		0.4	90					9.3	2448.61				
74	KRISHNA AMBADAS	60	M	10314	8.1.23	10.1.23	DFU	3	3	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	COR PULMONALE	PAH		NIV	26	MIXED	N	TOBBACO ALCOHOL	12	14.6	87.9	15.5	229	1.4													
75	MAHADEVI BANAKAR	66	F	448117	28.12.22	10.1.23	DAMA	1	14	PAIN	FALL	WRIST PAIN		I	COPD	T2DM	FEMUR #	BRONCHIECTASIS	NO	33	VEG	N		14	8.9	92.8	15.9	400	0.8	4			9.4	2.4			8.1	1696.91				
76	BASAPPA YALLAPPA	65	M	19722	16.1.23	23.1.23	DFU	3	8	BREATHLESNESS	COUGH WITH EXPECTORATION	FACIAL SWELLING		I	CHRONIC BRONCHITIS	T2 RESP FAILURE	HTN	CCF	MASK	33	MIXED	N	SMOKER	14	16.5	93.2	5.5	162	0.8	5			8.3					615.92				
77	BASAVARAJ B BENAL	63	M	17951	16.1.23	19.123	DFU	3	4	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	IHD	HTN		NO	29	VEG	RED	SMOKER	10	13.3	86.3	18.5	391	0.8	4.5			8.3					2166.2	109	2.8	136	
78	MALLIKARJUN BHEMANNA	65	M	20192	16.1.23	30.1.23	DAMA	1	15	BREATHLESNESS	COUGH	FEVER	ALTERED SENSORIUM	III	COPD	T2 RESP FAILURE	MODS	PNEUMONIA	V	7	MIXED	RED	ALCHOLIC	7	11.4	86.1	11.4	63	3.5	17	1.6	72.4	6.4	2.9	3802	1106	6.4	10000		6	131	
79	RAMAPPA DANAPPAGOL	74	M	23804	18.1.23	20.1.23	DAMA	1	3	BREATHLESNESS	FEVER			III	COPD	PAH	COR PULMONALE		MASK	17	MIXED	RED	ALCOHOL	8	12.1	91.2	14.3	226	0.8	5.2	1.3		9	3.8	50	26		923.35	680			5388
80	SHANTA BAISONNAGI	61	F	345678	2.10.22	13.10.22	DFU	3	12	COUGH WITH SPUTUM	CHEST PAIN			I	PUL EDEMA	AKI	HTN	CCF	V	29	MIXED	N		14	8.8	77.599	3.4	192	3.8	5.7	0.9		8	3.1	23	28				2.6	133	
81	MADIVALAPPA	70	M	16954	13.01.23	25.1.23	DFU	3	13	COUGH WITH SPUTUM	FEVER	BREATHLESNESS	L VOCAL CORD PALSY	I	COPD	BPH	COR PULMONALE	HTN	NIV	30	VEG	RED	SMOKER	12	15.5	89.6	10.4	234	0.9		0.9	33.1		3.8	48	32				4.6	136	
82	FARZANNA PATEL	60	F	26678	20.1.23	25.1.23	DFU	3	6	BREATHLESNESS	WHEEZE			I	COPD	HTN	T2DM		NIV	31	VEG	N		12	12.8	81.3	14.7	382	0.6	5.3	0.7		11.1	4.8	16	15	6.5					
83	SHANTABAI	60	F	271292	25.8.23	29.8.23	DFU	3	5	PAIN	NAUSEA VOMMITING	LOSS OF APPETITE		I	BRONCHIAL ASHTAMA	ACUTE PANCREATITS			NIV	28	VEG	RED	-	14	11.6	69	34.8	298	0.6	4	1.6		8	2.4	34	70		7592.82	32.7			
84	SUSHEELA BHAI RATHOD	72	F	272853	26.8.23	8.9.23	DFU	3	14	BLOOD IN STOOL	FEVER	BREATHLESNESS	CHEST PAIN	II	PNEUMONIA	BRONCHITIS	T2DM	HTN,MORBID OBST	NIV	38	MIXED	N		13	12.7	99.7	10.9	248	1.5	5.6	0.3		8.6	2.9			8.8		4.9	3.2	140	
85	SHRANAPPA GADHAPPA	65	M	253174	5.8.23	7.9.23	DFU	3	34	PAIN	ABDOMINAL DISCOMFORT			II	Lt. EMPYEMA	ICD	T2DM		MASK	29	MIXED	N		11	12.3	88.4	5.1	140	1.2	7.7			9.1				10.7	1514.68	6.9	1.5	141	1246
86	KASHIBAI CHANDRAM HATTI	85	F	274970	28.8.23	1.9.23	DFU	3	5	COUGH WITH SPUTUM	BREATHLESNESS	FEVER		I	COPD	IHD			MASK	24	VEG	RED	-	9	12.7	80.2	13.7	176	0.8	4			7.6							3.2		
87	KAMALABAI MUTTHAPA	62	F	277268	30.8.23	12.9.23	DFU	3	14	BREATHLESNESS	FEVER	COUGH WITH EXPECTORATION		II	PNEUMONIA	IHD	HTN		NO	38	VEG	N	-	14	10.6	86.2	9.2	264	0.8	3.6		90	9.4					589	8.8			
88	RUKMABAI RAUT	75	F	280537	13.8.22	01.9.22	DEATH	2	20	LOOSE STOOL	VOMMITING	PAIN ABDOMEN		II	PNEUMONIA	PLEURAL EFFUSION	AGE	FEMUR NECK #	MASK	19	VEG	RED		6	11.5	88.6	20.4	81	0.6		1.5			2	22	38	5.4	4240	100.7	4.3	135	
89	SHANKARAPPA PUJARI	60	M	281513	4.9.23	9.9.23	DFU	3	6	RTA	CLAVICLE #			VI	HEMOPNEUMOTHORAX	LEFT CLAVICLE FRACTURE			MASK	30	VEG	N		9	13	82.6	14.3	258	0.6	4.2	0.2		8.3	3.4	72	41				3.9	132	
90	MALLIKARJUN HIREMATH	75	M	282773	4.9.23	6.9.23	DFU	3	3	WEAKNESS	LOSS OF APPETITE	ALTERED SENSORIUM		II	PUL TB	RT PLEURAL EFFUSION	HTN	HYPOGLYCEMIA	MASK	21	MIXED	N		6	10.5	98.2	13.8	366	2.2		1			2.5	73	60			3812			2607
91	SHANKARAPPA TAMAGOND	67	M	282554	4.9.23	13.9.23	DAMA	1	10	COUGH WITH SPUTUM	BREATHLESNESS			I	COPD	T2DM			NIV	24	VEG	RED	ALCHOLIC AND SMOKER	10	12.5	106.9	7.3	132	0.6	4.6	1.4		7.5				7.6	1287		4.3	140	
92	LAXMIBAI CHANDRASHEKAR	65	F	278495	31.8.23	8.9.23	DFU	3	9	ABDOMINAL DISTENSION	COUGH WITH EXPECTORATION	FEVER WITH CHILLS	L/L SWELLING	II	PNEUMONIA	HTN	SEIZURES	RETINOPATHY	MASK	28	MIXED	RED	-	11	10.9	96.4	16.4	94	2.5	4.7	3.5		7.6	2.6	63	60			37.3			
93	BASAPPA WAGGAR	60	M	278421	31.8.23	7.9.23	DAMA	1	8	DECREASED APPETITE	FEVER	ABDOMINAL DISCOMFORT	VOMMITING	II	PNEUMONIA	HBSAG+	HEPATIC ENCEPH	THROMBOCYTOPENIA	V	22	MIXED	RED	SMOKER	2	11.1	80.2	11.8	24	0.8	3.2	5.5			1.9	43	60						
94	MIRABAI DESHPANDE	69	F	100549	6.9.23	13.9.23	DFU	3	8	BREATHLESNESS	COUGH			I	COPD	HTN			NO	34	MIXED	N	-	12	12.7	87	7.5	234	0.7	4.7	0.5		8.2	3.5	34	26				3.6	141	
95	SHYAMSUNDAR BAJAJ	73	M	215801	6.9.23	23.9.23	DFU	3	18	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	SEVERE PAH	SVT	AF	MASK	26	MIXED	RED	SMOKER	14	9.9	88.4	10.6	219	1.9	5.7		90	7.9					1841	31.7	4.1	147	
96	MAHANTAPPA GADDI	62	M	209146	17.8.23	23.8.23	DFU	3	7	ABDOMINAL DISTENSION	SLURRING OF SPEECH	TWITCHING OF FACE		II	PUL TB	PLEURAL EFFUSION	T2DM	HBSAG+	V	38	MIXED	RED	ALCHOLIC	11	9.7	77	11.5	122	0.6		1.3			3.4	70	31						
97	SHABGOUDA BIRADER	80	M	288857	9.9.23	10.9.23	DEATH	2	2	BREATHLESNESS	COUGH WITH EXPECTORATION	LOSS OF APPETITE		II	PNEUMONIA	Br. ASTHMA	MI		V	22	MIXED	N	ALCOHOL, TOBACCO, GANJA	14	12.5	98	18.1	119	1.3	11.4	1		8	2.4	68	34		987.99	576.8	2.6	144	
98	RUKMABAI KYATANKERI	75	F	291778	12.9.23	18.9.23	DFU	3	7	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	L EYE CATARACT			MASK	29	VEG	N		12	14.2	82.2	18.4	270	0.6	3.1	0.3		9.1	3.6	21	24				3.6	141	
99	SHANTABAI MALLIKARJUN	76	F	292099	12.9.23	17.9.23	DFU	3	6	BREATHLESNESS	BODYACHE	FEVER WITH CHILLS		II	PNEUMONIA	HTN			MASK	31	MIXED	N		13	10.5	84.1	18.7	344	0.7	3.7	0.6	23.1	8.4		16	20				4.5	138	
100	MALLAMA SHREEMNT	70	F	290196	11.9.23	2.10.23	DFU	3	22	BREATHLESNESS	COUGH WITH EXPECTORATION			I	COPD	T2DM	HTN		NIV	26	MIXED	N	TOBBACO CHEWER	14	13.6	85	10.3	210	0.8	4.8	0.6		8.4	3.9	30	53				3.5	134