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# Nutrition and Hospital Mortality, Morbidity and Health Outcomes

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## Abstract

Nutrition has a strong positive linear relationship with hospitalisation, recovery and death. Nutritional status serves as an independent predictor of hospital morbidity and mortality. There is an ensuing academic debate concerning the role and magnitude of nutrition in modifying health outcomes and the strategies that are to be employed to ensure nutritional adequacy. Professional, skill, knowledge and experience are important correlates that may modify patient outcomes, but hospitals continue to be under-resourced even in developed states. It is imperative that current standards, recommendations and policies be examined with the view to aligning the appropriate needs and services to realise positive gains with hospital mortality and morbidity.

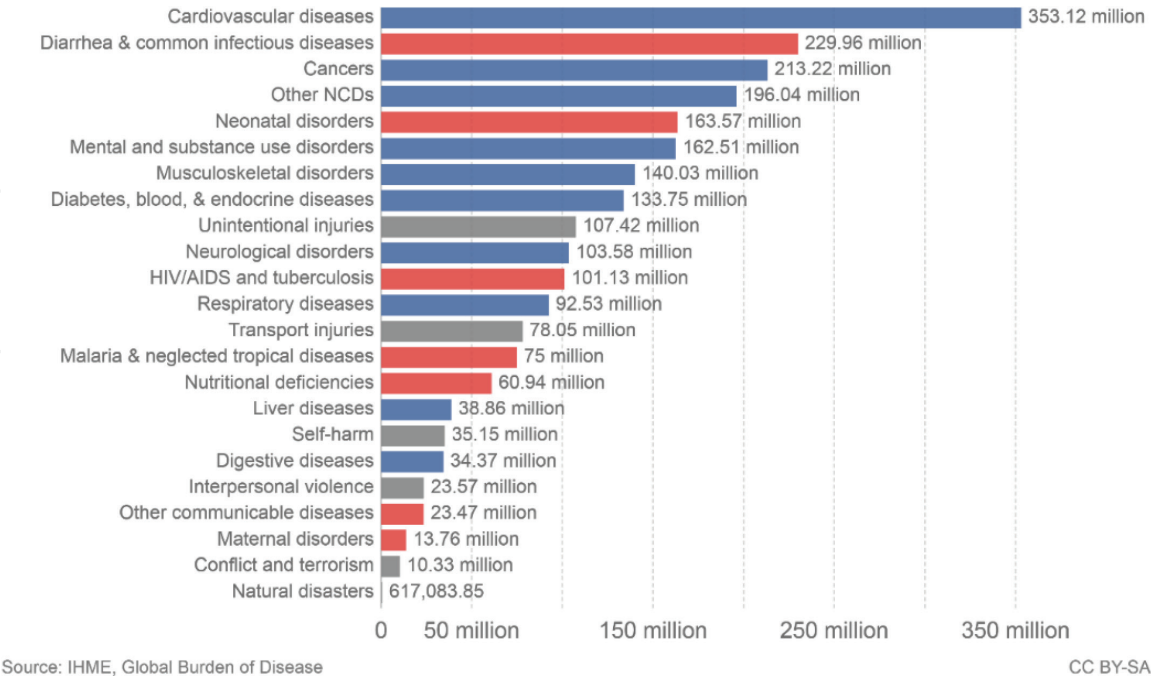
**Keywords:** nutritional adequacy, malnutrition, undernutrition, nutritional support, obesity paradox, hospital mortality

## 1. Global epidemiology and trends in malnutrition

The incidence of malnutrition has expanded exponentially over the last three decades. At either ends of the nutritional spectrum, malnutrition is concerning to health care professionals and transcends the economic status worldwide, affecting both developed and developing countries. According to the World Health Organization, the incidence of malnutrition is declining among children but remains at critical levels. In 2017, globally there were 151 million children under 5 years of age who were stunted, 51 million children classified as wasted and 38 million children who were overweight. Alternatively, The WHO identifies that global adult undernutrition examined using low body-mass index (BMI) as a proxy has decreased from 13.8% in 1975 to 8.8% in 2014; corresponding levels for women are 14.6 and 9.7%. Conversely, the incidence of malnutrition on the other extreme (overnutrition) was identified as being 1.9 billion among adults (accounting for 38% of the global adult population). Malnutrition has been defined as a health condition where there is an imbalance in the body's supply and usage of energy, protein and other vital nutrients resulting in discernible physiological changes and clinical health outcomes [1]. The epidemiology of malnutrition is difficult to track due to the expansive nature of the definition. Many studies reference malnutrition as undernutrition concerning only weight but the umbrella term also includes conditions of micronutrient deficiencies such as iron, calcium, vitamin A, vitamin D, magnesium, iodine, and vitamin B<sub>12</sub> which are the leading deficiencies globally. Moreover, overnutrition including overweight and obesity is often not classified as malnutrition, but the concept encompasses these states of nutrition

Burden of disease by cause, World, 2016

Total disease burden, measured in DALYs (Disability-Adjusted Life Years) by sub-categories of disease or injury. DALYs are used to measure total burden of disease - both from years of life lost and years lived with a disability. One DALY equals one lost year of healthy life.



**Figure 1.**  
*The global burden of disease. Source: Ritchie and Roser [2].*

and is important in the public health predictions for non-communicable diseases. Nutritional deficiencies are ranked in the top 20 leading worldwide disease and disability burden in 2016, according to the Institute of Health Metrics Evaluation [2], and is a pivotal global concern (see **Figure 1**).

The prevalence of malnutrition in hospitalised adults has been extensively reported in the international literature and varies between 13 and 78% among acute-care patients [3]. Reports pertaining to Latin America describe adult specific values with a much narrower range, with prevalence levels in hospitalised adults totalling 20–50% [4]. The variability in data may be due to tautology of the term, the assessment criteria and variations in institutions. Nevertheless, the impact on health outcomes are consistent across studies.

2. Outcomes of malnutrition

The effects of malnutrition are extensive and include delayed recovery and prolonged hospital stay, increased risk of morbidity and mortality, increased general practitioner visits, and an increased probability of admission to tertiary care facilities [3]. Correspondingly, other literature supports these data and reports that poor nutritional states are associated with increased morbidity and mortality, increased length of hospitalisation, more frequent re-admissions, increased infectious and non-infectious clinical complications and increased healthcare costs [4].

Hospital admissions, duration of hospitalisation and the economic burden of malnutrition have been studied extensively. Contemporary evidence points to a disparity in the length-of-stay (LOS) of adequately-nourished patients when compared with malnourished patients. South African data points to an observation that malnourished patients' LOS approximates 4½ days, which was 43% longer than the stay of the well-nourished patients. Earlier evidence identified an even

wider variance between the two states of nutrition, where malnourished patients had demonstrably significantly higher incidence of complications (27.0 vs. 16.8%), increased mortality (12.4 vs. 4.7%), longer LOS (mean of 16.7 vs. 10.1 days) and increased hospital costs [5]. Congruently, Canadian based assessments have also found that malnutrition directly contributes to lengthy hospital stay. After controlling for demographic, socioeconomic, and disease-related factors and treatment, malnutrition at admission was independently associated with prolonged LOS [6]. It was estimated that nutritionally at-risk patients have a fourfold increased cost of hospital care when compared with well-nourished patients in part due to their delay in recovery and the protraction of their hospitalisation. Moreover, in the United Kingdom in 2009, health costs associated with malnutrition was quantified as being at least £13 billion annually [3].

Though undernutrition is a public health issue that undermines the health outcomes of hospitalised patients, malnutrition in the form of overnutrition is also a complex public health challenge with debilitating impact on clinical outcomes and hospitalisations. Worldwide, at least 2.8 million people die each year because of overweight or obesity, and an estimated 35.8 million (2.3%) of global disability adjusted life years (DALYs) are caused by overweight or obesity [7, 8]. Weight related malnutrition is classified by several organisations including CDC, UNICEF [9] and WHO. The World Health Organization’s classification is made using weight and height indices and is outlined in **Table 1**.

Current epidemiological data provide concerning evidence of the global expansion of overnutrition. While substantial work has been undertaken to curtail the incidence of undernutrition which has improved over the last decade, there has been a significant increase in the incidence of overnutrition with corresponding increases in the prevalence of non-communicable diseases and poor quality of life.

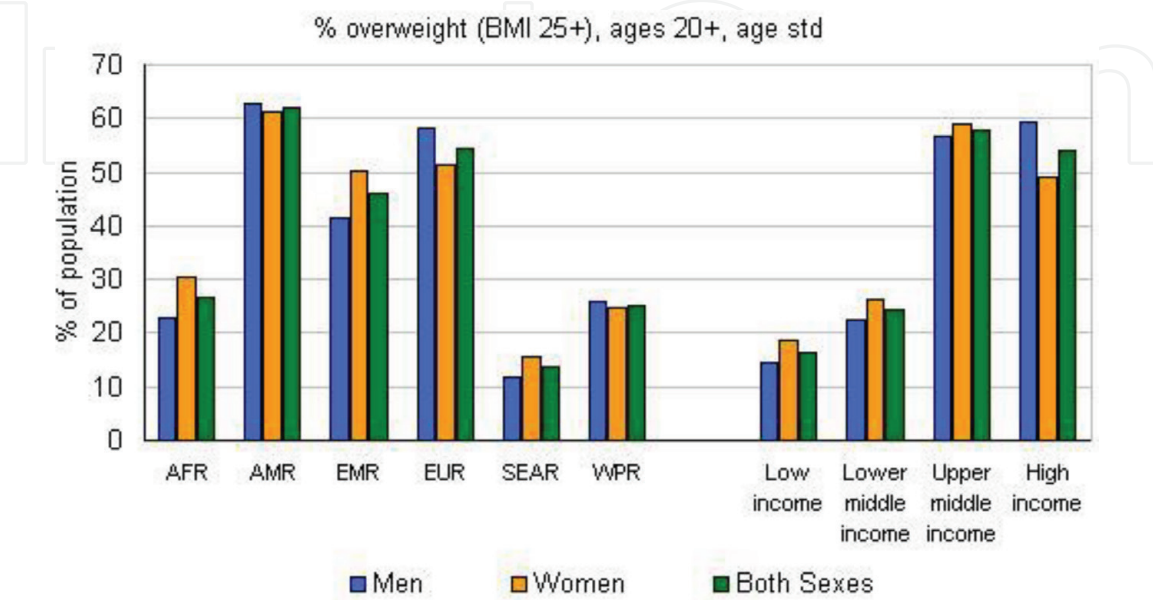
Classification	BMI (kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00–16.99	16.00–16.99
Mild thinness	17.00–18.49	17.00–18.49
Normal range	18.50–24.99	18.50–22.99
		23.00–24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00–29.99	25.00–27.49
		27.50–29.99
Obese	≥30.00	≥30.00
Obese class I	30.00–34.99	30.00–32.49
		32.50–34.99
Obese class II	35.00–39.99	35.00–37.49
		37.50–39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO (1995, 2000, 2004).

**Table 1.**  
International classification of adult underweight, overweight and obesity using to BMI.

The increase in the rates of obesity and overweight status is not only evident in developing and Agrarian societies but is also featured prominently in industrial societies. **Figure 2** provides a summary of the status of obesity and overweight in WHO regions in 2015 Global Health Observatory data. The WHO makes an even more stark comparison of developing and developing countries, the Organisation suggests that the prevalence of elevated body mass index increases with the income level of countries up to upper middle-income levels. The prevalence of overweight in high income and upper middle-income countries was more than twofold greater than that of low and lower middle-income countries.

Overweight and obesity influence health outcomes and hospitalisation. The prevalence of obesity is high among patients with type 2 diabetes and this may result in the omission of nutritional assessments for these patients [10]. Current evidence also identifies positive health outcomes associated with obesity in specialised admitted patients. European data provide evidence of lower in-hospital mortality and length of ICU stay in overweight and morbidly obese critically ill patients and is consistent with earlier studies that reported better clinical outcomes for critically ill patients with increased BMI [11]. The factors that underpin the physiological benefits of increased BMI in critically ill patients are related to the adequacy of metabolic substrates, the increased capacity for catabolism and increased energy reserves. However, the explanatory factors of improved mortality rates in ICU has not been well examined and many others have been advanced including differences in adipokines and inflammatory mediators, such as leptin and interleukin-10, secreted by fat cells, which are thought to have attenuative inflammatory properties thereby theoretically improving survival during critical illness. Another credible explanation is that persons with higher BMI may have lower severity of illness than their normal BMI counterparts through intangible means [11]. The nutritional status of ICU patients provides an interesting counterpoint to general hospital admissions, however global data on the epidemiology of obesity among patients admitted to ICUs remains limited. Yet, such data are important to understand the possible regional variability of the burden imposed by obesity on outcome and utilisation of healthcare resources. Correspondingly, other European evidence supports this report and identified a concept called the “obesity paradox” where a seemingly negative health condition (overnutrition) is associated with a



**Figure 2.** Global overweight status. Source: [7], concerning WHO regions for Africa, Americas, Eastern Mediterranean, Europe and South East Asia Regions and WHO Western Pacific Region.



positive clinical outcome (reduced hospital length of stay). Shorter hospital stay was reported in populations other than critically ill patients. Parissis et al., [12] found that patients with chronic heart failure, who also had higher BMI had associated lower in-hospital mortality.

Alternatively, and much more common are the negative health outcomes associated with overnutrition. There is a strong positive linear relationship between obesity, overweight and the incidence of non-communicable diseases. There is an analogous increase in the prevalence of comorbidities in tandem with BMI particularly concerning arterial hypertension, diabetes mellitus, and dyslipidaemia. Moreover, current evidence identified that overweight/obese patients represented most of Acute Heart Failure cases, as well as had a higher prevalence of non-cardiovascular comorbidities [12]. Furthermore, North American statistics provide evidence of an inverse near-linear relationship with in-hospital mortality and BMI [12]. Moreover, overnutrition is associated with an increased risk of worsened health status in diabetic patients. The evidence points to poor glycaemic control for obese diabetics when compared to normal weight diabetics [10].

### 3. Correlates and determinants of malnutrition

The paradigm of malnutrition is considerable, and the concept is linked with many factors. These determinants are usually categorised as clinical and social. **Figure 3** provides a summary of the determinants and correlates of malnutrition.

There are six major physiological factors that are described as influential on malnutrition statuses among people. According to Triantafyllidis et al. [14] the six main physical determinants of malnutrition, particularly undernutrition, are:

1. Decrease in oral intake due to primary physiological changes or secondary to health effects
  - a. Restrictive diets such as low carb, very low carbohydrate diets (VLCD), low fat, veganism among others
  - b. Therapeutic fasting related primarily to presenting health condition such as in gastrointestinal disorders like Crohn's and ulcerative colitis and with bowel prep before gastrointestinal surgeries, or due to diarrhoea, abdominal pain, nausea, and vomiting
  - c. Alteration in taste due to drugs, vitamin and mineral deficiencies including in zinc deficiency, and with proinflammatory mediators
  - d. Anorexigenous effect of proinflammatory cytokines
2. Gastrointestinal losses which impair energy and nutrient balances
  - a. Diarrhoea
  - b. Rectorrhagia (rectal bleeding without faeces)/hematochezia (bleeding with stools)
  - c. Loss of mucus and electrolytes
  - d. Protein-losing enteropathy (disease of the small intestine)

3. Metabolic disorders which interferes with energy balance

a. Increase in resting energy expenditure due to inflammation, fever, and sepsis

b. Enhanced fat oxidation

4. Increase in nutritional requirements due to increase substrate requirement for macro and micronutrients with subsequent switch from anabolism to catabolism

a. Inflammatory states

b. Increased basal oxidative metabolism—including during fever

c. Infectious complications-with activated immune response

d. Postsurgery with substantial tissue repair

5. Drug interactions limiting absorption, digestion and usage of essential micro-nutrients—vitamins, minerals and electrolytes

a. Corticosteroids and calcium reabsorption

b. Corticosteroids and protein catabolism—influencing turnover and nitrogen balance

c. Salazopyrin and folate absorption

d. Methotrexate and folates

e. Cholestyramine and fat-soluble vitamins

f. Antimicrobials esp. cephalosporins and vitamin K; inhibit endogenous metabolism and intestinal absorption

g. Antisecretors and iron

6. Gastrointestinal or support organ structural dysfunction resulting in poor absorption of nutrients

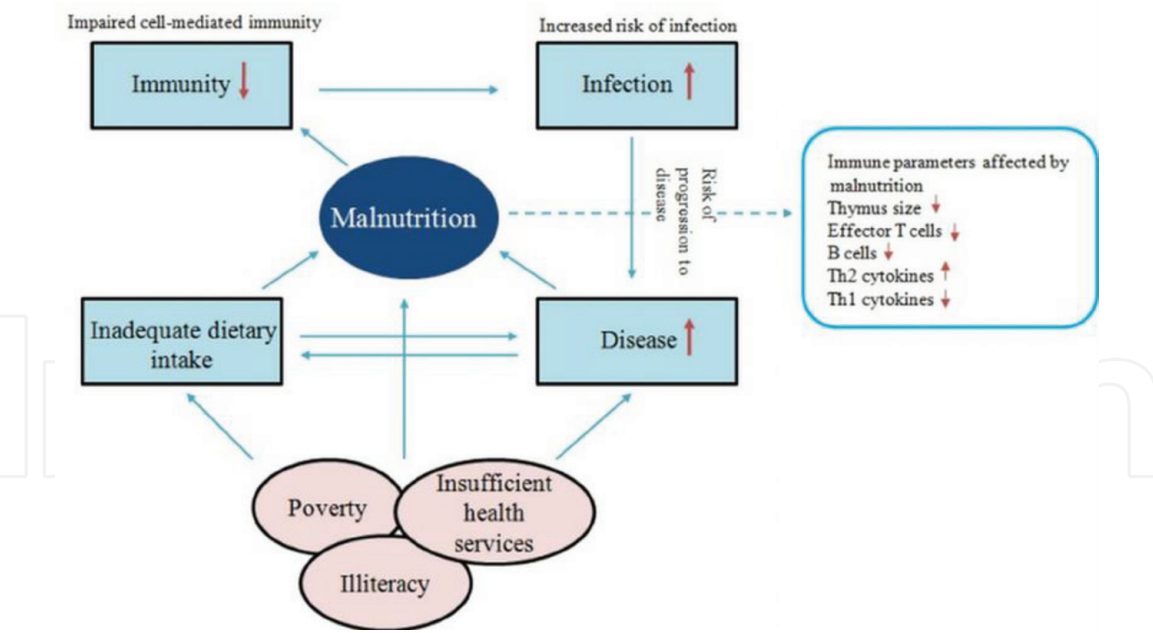
a. Reduction of the absorptive surface due to intestinal resection and enteric fistulas and high output fistulas

b. Blind loops and bacterial overgrowth

c. Poor absorption of bile salts in ileitis or resection

d. Mucosal inflammation and inflammatory diseases [14]

Alternately, the determinants of overnutrition are fewer and varies widely from those resulting in undernutrition, however the concept of energy and food intake is consistent across malnutrition categories. There are definitive proponents of obesity



**Figure 3.**  
*Factors influencing malnutrition. Source: Bapat et al. [13], p. 2.*

development. It is documented that increased consumption of energy dense foods which are correspondingly poor in micronutrients, greater than physiologic demand will lead to weight accumulation, shifting the beam of the pendulum from balance to excess [10]. North American data identifies biological, behavioural and social contributors of obesity, insomuch as Lifshitz and Lifshitz [15] proposes that the causes of obesity are multifactorial, they include:

1. A genetic predisposition
2. Hormonal activity
3. Health status and disease burden
4. An environmental susceptibility to gain weight
5. Increased energy intake
6. Reduced energy expenditures
7. Structural environmental changes creating an obesogenic environment
8. Abundance of high-caloric density, low-quality food
9. Food selection/preparation
10. National and international food policies

The factors increasing the risk of malnutrition exist for malnourished states central to as well as external to hospitalisation. Though the factors outlined hitherto contributes significantly to hospital-based malnutrition, the unique concept of hospitalisations worsens the risk and the incidence of malnutrition. In secondary care facilities malnutrition, and more frequently undernutrition, develops as a result of insufficient energy and nutrient intake, impaired digestion/absorption/



utilisation or loss of nutrients due to illness or trauma through wounds, fistulas, or excreta as well increased metabolic demands during illness, recovery, and physiological response [4]. There remains no consensus on the definition of malnutrition, especially undernutrition, with a profusion of criteria possibly explaining some of the inconsistencies in the prevalence rates reported in the literature. Generally, unintentional weight loss >5% in a short period of time (over 3–6 months) and decreased food intake are among the definitive parameters of undernutrition [4]. Consistent with the challenges in defining malnutrition, so too is there challenge in delineating all the factors that correlate with malnutrition, particularly undernutrition.

Supportive evidence precedes these assertions and describe the causes of “disease-related malnutrition” as being inclusive of insufficient food/nutrient intake, impaired nutrient digestion and absorption and increased requirements for nutrients with increased losses (e.g., from wounds, malabsorption) and catabolism [1]. While other evidence points to a strong social link, where nutritional status at hospital admission is said to be compounded by primary malnutrition mainly reflecting poor socioeconomic conditions, and secondary malnutrition usually influenced by the impact of degenerative, terminal and chronic diseases [16].

Acute malnutrition takes place in a few weeks to months, it primarily affects lean body stores and is usually managed effectively to prevent permanent impact, especially in children. It occurs in a range of instances including during emergencies, seasonally and endemically [17]. These situations usually contribute to undernutrition through severe restrictions to nutrient and energy supply. In the former case, hospital-based emergencies may result in medium term therapeutic fasts, while in countries which rely heavily on agriculture and have variable weather pattern, food security may be critically impacted creating a unique form of dietary restriction. In undernutrition, there is a greater risk of death which is related not only to the infection but also to the loss of muscle mass with concordant limits to immunity and primary metabolic functions. Fat stores, which are used up in cases of undernutrition without infection, may also play a role in survival and regulate bone linear growth [17].

#### **4. At risk groups**

In as much as malnutrition is debilitating and associated with severe health outcomes, there are vulnerable groups for which malnutrition, particularly undernutrition, is more likely to affect and by extension more probable to result in death. The literature suggest that malnutrition is a problem in many different disease groups, including cancer (5–80%), neurology (4–66%), surgical/critical illness (0–100%), respiratory disease (5–60%), gastrointestinal and liver disease (3–100%), HIV/AIDS (8–98%) and renal disease (10–72%) [1]. Over a similar period in Cuba the rates of undernutrition were alarming 41.2% were classified as undernourished and 11.1% of patients were considered severely undernourished. Malnutrition rates increased progressively with prolonged length of stay [18]. Current evidence highlights that patients who are hospitalised are at risk of developing iatrogenic malnutrition or hospital-based malnutrition due to several reasons. Patients admitted in hospitals, for instance after an acute exacerbation of a chronic condition, are at high risk of developing disease-related malnutrition (DRM) a consequence of loss of appetite, poor nutritional intake, and disease-related catabolism and in severe instances cachexia [19]. In addition to the clinical conditions that may predispose patients to malnutrition, age and gender are also factors which create additional risk. Children and infants with limited physiological and nutritional

reserves, pregnant women who must physically meet her needs and that of a growing foetus as well as the elderly are numbered among the vulnerable, nutritionally at-risk group. Hospitalised elderly patients are particularly vulnerable to develop DRM because of poor nutritional antecedents including decreased fat free mass and impaired protein, energy, and fluid intake [19]. Consequently, care must be taken to screen, assess, manage and follow up patients who are at-risk of malnutrition in an effort to reduce the associated risk of mortality and morbidity across differing health conditions/disease states and the lifecycle [20].

## **5. Malnutrition across the lifespan**

Negative health outcomes resulting from poor nutrition is pervasive across all life stages and impacts individuals differently in each group due to physiological and developmental differences among groups. Consequently, health care professionals must be keen to ensure that the unique characteristics and risks in each group are evaluated. Therefore, international organisations such as PAHO, WHO and CDC have instituted concerted efforts, but the rates and impact of childhood malnutrition continues to be extensive. Childhood is characterized by a period of dependence, rapid growth and limited nutritional reserves accordingly, parental neglect, limited knowledge and socioeconomic capacity may negatively influence nutritional adequacy. Globally childhood malnutrition continues to be a public health problem with alarming statistics in 2015, out of the 1.5 million children who died, nearly half (45%) of these deaths resulted from malnutrition or its correlates [21]. In the Latin America and the Caribbean, the rates are more concerning with infant mortality rate being 11 per 1000 live births in Barbados [22]. Furthermore, infants and children exposed earlier and more sustainably to poor states of nutrition have a greater probability of experiencing more severe and chronic health outcomes as a result. In utero as well as cohort studies of the Latin Americas and the Caribbean and European societies suggest that foetus exposed to poor maternal nutrition, and children 0–6 months old exposed to poor nutritional profiles are more likely to be hospitalised, exhibit mental disorders such as personality and schizoid disorders and have chronic diseases including hypertension and diabetes [22, 23]. Moreover, European evidence points to greater episodes of diarrhoea, vomiting, poor recovery, longer hospital stays and greater health care costs in admitted children with body mass indices less than two standard deviations in children compared to healthy controls [24]. Nevertheless, the morbidity associated with nutritional inadequacies in children can be attenuated with early and appropriate nutritional interventions. Studies concerning the Caribbean and West African population have shown that the rate of hospitalisation and mental illness associated with poor childhood nutrition declined with nutritional supplementation in both Barbados and Mauritius [23].

Similar to the physiological impact in infancy and childhood, pregnancy and lactation create nutritional vulnerabilities for the foetus and the mother. The additional metabolic demands, nutritional requirements of the foetus and the capacity to support the organ changes coupled with emotional and physiological factors limiting dietary intake increase the risk of nutritional inadequacy in pregnancy. Current evidence suggests that it increases the risk of morbidity and mortality for both the mother and the unborn child. In Latin America, there are reports of a lack of specialised tool to examine maternal nutritional states as well as a lack of protocols to guide nutritional support and intervention [21]. In pregnancy, poor maternal weight gain, low haemoglobin levels, and impaired fasting plasma glucose levels, as well as poor maternal dietary intake and physical inactivity are important predictors of infant mortality, maternal mortality, low birth weight and poor infant

growth and development [21]. The authors suggest that assessment, screening, follow-up and maternal care are important modulators of these outcomes.

For adolescents, the portion of the lifecycle is characterized by rapid growth and organ development, greater autonomy and independence, access to media and dietary advice. Contingent on the adolescent's support and capacity to negotiate these changes he may be at risk of developing micronutrient deficiencies such as iron and calcium, or experience macronutrient imbalances associated with obesity and wasting as well as eating disorders such as anorexia nervosa and bulimia [25]. Growth should be monitored at regular intervals throughout childhood and adolescence and should also be measured every time an adolescent visits a healthcare facility for preventive, acute, or chronic care. In children ages 2–20 years several nutritional and developmental indices should be measured as a standard procedure to identify and treat potential nutritional risks and disorders including standing height-for-age, weight-for-age, and body mass index (BMI)-for-age [26].

While adolescence malnutrition is plagued with equal risks of acute and chronic outcomes, in adulthood the risks associated with nutritional imbalances have greater links to chronic illnesses such as cardiovascular and endocrine disorders. These disorders worsen morbidity risk in nutritionally unhealthy adults through poorer quality of life and longer periods of disability adjusted life years (DALY) mainly as a result of the contribution of overweight and obesity. Similarly, underweight, using mid upper arm circumference as a proxy for assessment, has shown strong negative correlations with in-hospital mortality in adults. It accounted for a nearly (3.8) fourfold increased risk of in-hospital mortality when compared with healthy controls [27]. Other evidence points however to a protective effect of obesity on in-hospital mortality in adults where odds of death was 0.9 and 0.7 in overweight and obese patients compared to normal weight adult counterparts. Other evidence however confirmed the findings of Asiimwe [27] inasmuch as it reports that the odds of dying were higher in hospitalised undernourished adult patients [28].

Nutritional health maintenance and its sequelae of outcomes are similarly perplexing in the elderly. They have a double burden of increased micronutrient requirements such as iron, calcium, and phosphorus with a discordant reduction in the requirement for macronutrients. In the face of this conundrum, the health care provider must be careful of the nutritional prescriptions to balance macronutrient requirements to attenuate chronic disease risk as well as to maintain adequate micronutrient requirements to prevent and manage important metabolic changes associated with the physiological features of aging. Furthermore, the older adult is described as nutritionally vulnerable because he has reduced physical reserve that restricts the ability to mount a vigorous recovery when there is an acute health threat or stressor [29]. In developing as well as developed countries malnutrition is identified as an independent predictor of mortality. The mortality rate in malnourished elderly Brazilians aged between 60 and 69 years was 3.34 deaths per 1000 inhabitants, and among those aging 70 years and older, 11 deaths per 1000 inhabitants [30]. The factors contributing to the elderly's nutritional vulnerability include multiple medical conditions, and polypharmacy, physiological changes affecting intake and absorption including xerostomia, anorexia of aging and achlorhydria, obesity, and limited socioeconomic resources. Conversely, having adequate muscle mass, replete micronutrient stores, healthy dietary practices and adequate social support are protective factors against nutritional inadequacy in the elderly population [29]. Consistent across all life stages is the risk of nutritional ill health, unique to each segment of the cycle is a physiological and development paradigm that creates a distinctive risk for the individual. Critical to the successful negotiation of the life stage is the public health role that providers play, they must be equipped to



screen, assess, diagnose, and prescribe appropriate individualised plans and evaluate nutritional outcomes. It is important therefore for the health care provider to be conversant regarding the procedures for managing both elements of the spectrum of malnutrition.

## **6. Management of malnutrition**

Comparable with the debate concerning the criteria for defining undernutrition, there continues to be a rigorous academic discourse surrounding the management of undernutrition.

Though the debate is still raging, institutes such as BAPEN, ASPEN and ESPEN and health professionals have advanced nutritional prescriptions linked to the energy, amino acid and electrolyte needs. Protein and energy supply in undernourished patients contribute to supporting metabolic reactions, providing substrates for immune functions and expansion of lean body reserves, while electrolytes and major minerals such as iron, sodium, phosphorus and potassium are essential for electrical and neuronal conductivity and several metabolic homeostatic reactions. Energy and protein recommendations are usually the most varied elements of the debate, nevertheless contemporary and classical evidence converges on the general recommendations for nutritional support of undernourished clients. These patients should be prescribed a diet based on the following allowances: protein, 1.1–1.5 g/kg; calories, 30–35 kcal/kg; sodium, 87–120 mEq/day; potassium, 1.1–1.5 mEq/kg; phosphorus, <17 mg/kg. Additional nutritional supports in the form of high-protein or high-protein and high-calorie supplements were also provided to individual patients whose weight was <80% of their habitual body weight, if they had more than 3 kg (5–7 lb) of weight loss in a month, and/or their serum albumin was <3.5 g/dl [31, 32]. Despite the benefits that can be accrued from nutritional support, the problem is still evident in the Low and Middle-Income countries of the Latin Americas. In eight Latin American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, and Peru), malnutrition was found to be prevalent among hospitalised patients and caloric intake failed to meet targeted energy delivery in 40% of hospitalised adults receiving nutrition therapy. The evidence suggested that supplemental administration of parenteral and enteral nutrition was associated with improved energy and protein delivery and reduced mortality levels [33].

For children, malnutrition-especially undernutrition may be more incestuous and accompanied by infectious diseases, worm and helminth infections and involve both macro and micronutrient deficiencies. Current evidence outlines that childhood malnutrition is a significant contributor to mortality rates of children under five. The risk of death may be attenuated by energy supply dependent on calorimetric determinants and earlier antibiotic therapy [34].

## **7. Nutritional screening, assessment and evaluation**

To effectively manage undernutrition, patients' nutritional status must be determined, and the nutritional prescription individualised based on their needs. Screening and assessment are the procedures necessary for the classification of client's nutritional status. Furthermore, nutritional risk screening is an important modulator of mortality and morbidity risk particularly in hospitalised surgical patients [35]. Current research supports this finding, as nutritional screening is described as one of the most critical initial steps in nutritional management. Many

health care professional groups (ASPEN, BAPEN and ESPEN) currently recommend nutritional screening of acute care patients, either before elective admissions or within 24–48 h after emergency admissions. It is imperative to identify and classify malnourished patients promptly to prevent or counter the associated negative health outcomes. Currently, physicians and nurses assess patients on admission to hospital, and it has been suggested that they are in an ideal position to screen patients for malnutrition [3]. Moreover, clinicians suggest that nutritional status evaluation include clinical and biochemical assessments. Standard biochemical assessments should include basic serum electrolyte tests as well as serum albumin and prealbumin levels which are direct markers of lean body mass. For several authors, serum albumin level is the best prognostic indicator of nutritional status because of its ability to detect protein-energy malnutrition, which may not be accompanied by declines in body mass index and body weight or may be sub-clinical especially in the acute phases. Additionally, serum albumin level was identified a better predictor of some types of morbidity, particularly sepsis and major infections, than other types [36].

Effective nutritional management strategies include: appropriate weighing practices; documentation of weight fluctuations; monitoring of biochemical parameters and food intake; and clear malnutrition identification criteria through nutritional screening. Using nutritional experts and multidisciplinary nutritional teams is also recommended to help combat malnutrition [3].

Furthermore, there abounds a plethora of algorithms that outlines effective nutritional management procedures inclusive of screening, assessment and intervention guidelines. There are disease specific algorithms as well as population specific protocols available including guidelines from ASPEN as outlined in **Figure 4**.

Algorithms such as the one advanced by ASPEN are available and supported by hospital protocols but there remains low levels of nutritional screening and assessment particularly in resource restricted low-income countries such as Latin America and the Caribbean, the rates are troubling. In a study of 14 countries, only two were found to have national policies regarding best practices for nutrition therapy in hospitals or long-term care facilities and this data was associated with only 9% of patients who required parenteral or enteral nutrition receiving the treatment [4].

In children, several indices have been identified by health authorities including the WHO as being suitable in identifying malnutrition and its risk. Current evidence points to mid-upper-arm circumference (MUAC) providing better estimates of childhood mortality when compared with weight-for-height. Weight-for-height is unstable and variable in acute conditions affecting body water. It is

Figure 4.

Nutrition care algorithm. Source: [37], p. 17.



more sensitive to dehydration, such as in the case of diarrhoea, where dehydration causes weight loss with little impact on lean body mass [17], therefore MUAC which is more robust against these changes, is recommended as a more stable measure of nutritional status and risk.

## 8. Professional and nutrition care

Consistent with the need for nutritional screening, assessment and evaluation, is the poignant value of hospitals and primary as well as tertiary care facilities being staffed with professionals knowledgeable, skilled and resourced to deliver adequate nutritional support. In stark contrast to this recommendation is the reality of the characteristics of human resources that people these institutions. In some studies, provider knowledge, understanding and data usage was identified as a barrier to optimal nutritional support [38]. In Swedish settings, limited access to nutrition related education as well as availability of training programmes were identified as having negative effects on nutritional support and management [39]. Furthermore, there is low nutrition related health literacy among health care professionals partly attributable to a weak “nutritional culture” correspondent with inadequate academic training and preparation of health care professionals [40]. This partly due to limits in the nutritional education and training afforded to health care providers.

*“The quantity of formalized nutrition education is shrinking in the curricula of health professions, such as physicians, nurses, dietitians, and pharmacists. The current nutrition education being taught in U.S. schools of healthcare professionals does not appropriately prepare students for identification of patients at nutrition risk or management of undernourished hospitalized patients with specialized nutrition therapies...” ([41] p. 218).*

While health care workers recognised the value of nutritional screening and assessment, deficiencies in their knowledge and skill limit the benefits that could be accrued from early and consistent nutritional evaluation. Coupled with individual level limitations there are also policy level challenges as well as institutional and nationally challenges in some respects [39]. In the Latin America, the culture, value, and significance of nutritional support in health care are limited even as the prevalence of malnutrition and its outcomes rise. The increased rates of community and hospital malnutrition and its morbidity and mortality risks in Latin America occur alongside a limitation in the awareness levels of providers concerning the management of disease-related malnutrition [42]. It however, represents an opportunity to improve nutrition care by increasing education and training. Healthcare administrators, clinical leaders and educators, and clinicians must first recognise the significance of nutrition to health care and then must be knowledgeable in order to realise the benefits of nutritional support in hospitals.

Though there are inconsistencies in the proponents’ views on the diagnosis and treatment of malnutrition there is consensus on the need for treatment and the value of nutritional support to health care outcomes. Current guidelines published by the European Society for Clinical Nutrition and Metabolism (ESPEN) provide primarily recommendations for nutritional therapy specific to organ/system dysfunctions and medical specialty [19]. However, large developed and developing countries fail to institute these recommendations in the abundance and the absence of adequate resources. Knowledge, experience, self-confidence, and self-efficacy may be the intangible factors constraining the implementation of these guidelines. Current evidence points to their impact on negative clinical and health outcomes

including worsening risk of mortality and morbidity as a consequence of under-treatment of vulnerable hospitalised patients.

Significantly, developed and emerging societies are plagued with malnutrition and its consequences as well as institutional and provider level incompetencies to manage the spiralling problem. The burden is more severe in resource restricted countries. To attenuate the negative effects of malnutrition developing countries should employ the following strategies:

1. Evaluate, adopt and customise appropriate nutritional management algorithms to guide health care practitioners
2. Institute appropriate national and institutional policies to guide and support the use of nutritional treatment protocols
3. Assess the training and educational needs of the health care teams
4. Organise regular and contemporary education/training procedures and updates for all members of the health care team
5. Engender a culture of nutritional significance and value to health care development and recovery
6. Reinforce nutritional evaluation and follow-up during and post hospitalisation
7. Adopt international primary and public health strategies to minimize primary malnutrition risk
8. Support the documentation of unique nutritional support procedures and the statistics concerning nutritional management

## **9. Conclusion**

The global incidence of malnutrition is significant. Nutritional inadequacies directly impact hospital morbidity and mortality rates, worsening death for the most parts and to a lesser extent obesity has been linked to a protective effect. The condition severely diminishes quality of life for individuals of all ages. Health care providers through their capacity and responsibility to screen, assess and intervene serve as critical modulators of malnutrition outcomes. Nevertheless, their attenuative capacity is severely restricted through limited nutrition health related culture, training, education and resource limitations. Notwithstanding the significant challenges, countries and health care institutions must recognise the role nutrition plays in morbidity and mortality and institute effective action, including training and education, as well as policy and resource provision in order to stymie the negative impact of nutrition on morbidity and mortality.

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