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## Review Article

### Principles of Nutritional Support in Cancer Patients

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## Abstract

Cancer patients are already compromised on nutrition. A good nutrition plays a very important role in cancer patient. Malnutrition delays overall recovery of patient from cancer treatment and may lead to further Serious Complications. On the other hand, regular exposure of cancer patient to anti cancer therapy leads to inadequate nutrient intake and subsequent malnutrition. According to American Institute for Cancer Research and the World Cancer Research Fund, it was estimated that approximately 30-50% cancer can be prevented by good healthy diet, physical activities and proper maintenance of body weight [1]. Health care professional should screen malnutrition at early, during and post treatment phase and manage these issue according to the available guidelines. This review article will focus on ideology of nutrition, method of assessment for malnutrition, and Garson therapy in context to cancer patient.

**Keywords:** Nutrition; Malnutrition; Parenteral Nutrition; Enteral Nutrition; Gerson Therapy; Cancer

## Abbreviations

BMI: Body Mass Index;  
PCM : Protein-Calorie Malnutrition;  
PChE: Pseudo Cholinesterase;  
TLC: Total lymphocyte Count;  
CRP: C reactive protein;  
NRI: Nutrition Risk Index;  
MUST : Malnutrition Universal Screening Tool;  
NRS: Nutritional Risk Screening;  
ASPEN: American Society for Parenteral and Enteral Nutrition;  
ESPEN: European Society for Clinical Nutrition and Metabolism;  
DXA: Dual Energy x-ray Absorptiometry;  
PG-SGA: Patient-Generated Subjective Global Assessment;  
QOL: Quality of Life

## Introduction

The term nutrient was derived from Greek word “norisshe” (around 1250). Nutrition plays an important role in treatment of Cancer patient [2]. According to dictionary, a Nutrient can be defined as a “Substance that an organism must obtain from its surroundings for growth and sustenance of life”. Nutrients are divided into two main categories: essential and non essential nutrition. Essential nutrients are those which are not synthesized within the human body and must be absorbed from the surroundings. Nonessential nutrition refers to those which can be synthesized within the human body. They are a source of energy and are the major ingredient for structural and functional build up of the human body.

Poor nutrition of a cancer patient may cause malnutrition which may leads to severe side effects, consequently increasing the risk of infection and eventually reducing chances of survival [3]. Malnutrition is a common problem in patient with cancer and result to potential significant adverse outcomes. Lack of appropriate Nutrient increases the morbidity and mortality rate and decreases the quality of life (QOL) Cancer patients undergo tight treatment regimens and suffer pain which would affect them both physically and mentally. On the other hand, by controlling diet and improving on life style, chances of cancer can be reduced up to 30 to 40% [4].

During diagnosis, it was found out that 80% of the patients with gastrointestinal cancer and 60% of patients with lung cancer had experienced a significant loss of weight [5]. Weight loss has been referred to as a poor prognostic factor in cancer patients [6]. By maintaining weight and body's nutrition, symptoms will improve faster that in turn will improve the quality of life [7]. Associated signs and symptoms in relations to poor nutrition including Nausea, vomiting, diarrhoea, constipation, stomatitis, mucositis, dysphagia, alterations in taste and smell, pain, depression, and anxiety to name a few. The mentioned events are the most prevalent ones in cancer patient and they may be seen nonspecifically as a consequence of the cancer itself as well as treatment modalities such as chemotherapy and radiation [8]. In early stage of Cancer, Chemotherapy may react with undesirable weight gain due to decrease in resting metabolism [9]. The aim of nutrition assessment is to determine the condition of malnutrition and to identify the patients that are nutritionally at risk [10].

After a person is diagnosed from cancer, PCM diagnosis is the next step. This originated from the lack of carbohydrate, protein and fat to meet metabolic prerequisites and/or the decreased absorption of macro-nutrients [11]. Anorexia, i.e loss of appetite is present in 15% to 25% of all cancer patients [12]. Depression, failure of personal interests or desire and apprehensive attitude are the outcomes of PCM (*Protein-calorie malnutrition*) [13]. The abnormalities of PCM comprise of glucose intolerance and insulin resistance, increased lipolysis and increased whole-body protein turnover. It causes progressive wasting, weakness and debilitation, since protein synthesis is reduced and lean body mass is lost, probably leading to death [14].

## Nutrition

“Nutrition can be defined as the intake of food and relevant ingredients by the body for growth, metabolism and repair.” This whole process is classified into different stages: ingestion, digestion or processing, absorption, transport, assimilation, and excretion.

A Good nutrition is important for a good health and a better immunity. Eating right diet before, during, and after cancer treatment can help the patient to feels better; maintain body weight, lower chances of infection and stay stronger and more energetic. A healthy diet includes the right quantity of foods and liquids that have all important nutrients (vitamins, minerals, protein, carbohydrates, fat, and water) and calories valuable for the body's rehabilitation [15]. When the body does not absorb the nutrient needed for health, it causes a condition, known as malnutrition. Anorexia and cachexia are the common causes of malnutrition in a cancer patient.

## Malnutrition

Malnutrition is a condition of t in which deficiency, excess, or imbalance of the protein calories ratio leads to serious side effects on the functional aspects and clinical outcome of the body. In cancer patients disease progression and exposure to different therapies are specifically the root cause of Malnutrition. Exposure to therapies like surgery, chemotherapy, radiation and immunotherapy cause deterioration of important nutrients in cancer patients. 30 – 85 % of cancer patient are observed to have incidence of malnutrition [16]. Approximately 20% of cancer patients were died due to malnutrition.

Malnutrition can be of two types:

**Sub-malnutrition or Undernutrition** - When the body does not get enough nutrients

**Over-nutrition** - When the body gets more nutrients than normal diet

Malnutrition can impact a person's physical, physiological and psychological wellbeing, as outlined in the following table 1[17].

	Effects	Consequences
Physical	Impaired growth and development	Increased risk of pressure sores
	Reduced fat and muscle tissue, reduced strength and lethargy	Reduced mobility and increased risk of falls
	Reduced ability to cough	Increased risk of respiratory infections
	Impaired regulation of body temperature	Increased risk of hypothermia
Physiological	Impaired immune function	Increased risk of infection
	Impaired wound healing	Prolonged period of recovery
	Altered drug metabolism	Increased risk of side effects
Psychological	Apathy and depression	Reduced quality of life
	Impaired cognitive function	Memory loss

## Etiology of Malnutrition

Reduction of weight in cancer patient is dependent upon catabolic mediators and progression of inflammation [18]. Other possible etiology might be increase in tumor mass that can lead to mechanical obstruction of the digestive tract and/or impaired organ function which can cause varied side effects like nausea, vomiting, dysphagia, abdominal pain or insufficient digestive secretions. This is particularly important in cancers originating from the gastrointestinal tract or within the abdomen [19].

## Nutrition Screening and Assessment

Cancer patients are physically and psychologically compromised due to their physically challenged metabolism and disease progression. A cost effective, fast, reliable, feasible and noninvasive tool is required for the early detection of malnutrition in cancer patients. The patient is evaluated on the basis of the following criteria and data generated helps in assessment of nutritional status.

Physical evaluation which include demographical analysis like age, gender, occupation, life style

Current tumor status and past history with management if any

Anthropometry which includes actual weight, BMI\*, healthy weight, weight loss or symptoms appearing since the start of illness, a chart representing data of weight loss during last week, last month and last 6 months

Clinical Examination, Screening Grade Assessment (SGA) tool, Karnofsky Index (evaluating functional capacity)

Biochemical data: total lymphocyte count(TLC),cholesterol, serum albumin, prealbumin, C reactive protein (CRP), pseudocholinesterase (PChE), Cytokines - IL-6, and Procalcitonin level

Food assessment before the treatment and after the treatment

**\*BMI-the weight in kilograms divided by the height in meters squared (kg/m<sup>2</sup>)**

There are a number of nutrition screening tools available for assessment e.g. Malnutrition. Nutrition Risk Index (NRI), Malnutrition Universal Screening Tool (MUST), Nutritional Risk Screening (NRS) 2002, and Mini Nutritional Assessment (MNA). Mini Nutritional Assessment (MNA) is commonly used in practice for screening of malnutrition in general population. For cancer patients, Scored Patient-Generated Subjective Global Assessment (PG-SGA) is one of the popular tools for nutritional status analysis.

It is recommended to perform the nutritional assessment

prior to the initiation of anti-cancer treatment or at the time of diagnosis. The nutrition assessment should be made by combining subjective information from the patient and from the objective medical data [20]. Malnutrition not only compromises survival, but also has a major adverse effect on the quality of life. Various studies have shown that malnourished cancer patients have higher rates of hospital readmissions and longer hospital stays, increased symptom distress, reduced quality of life, reduced muscle strength and a reduced functional status. Physical and clinical examination and past history should be recorded and analyzed very carefully.

## Calculation and Interpretation of Weight Data

“Body mass index (BMI) is used as a screening tool to identify possible weight problems in adults. Further assessments might include skin fold thickness measurements, evaluations of diet, physical activity, family history, and other appropriate health screenings”[20]. BMI does not measure body fat directly, but research has shown that BMI correlates directly to the measurement of body fat, just like underwater weighing and dual energy x-ray absorptiometry (DXA)” [21].

For adults 20 years old and older, BMI is interpreted using standard weight status categories and is same for all ages for both men and women. For children and teens, on the other hand, the interpretation of BMI is both age- and sex-specific. The standard weight status categories associated with BMI ranges for adults are shown in the following table 2 [22].

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

**Table 2:** Standard weight status categories associated with BMI ranges for adults

## Subjective Global Assessment Tool Analysis

Many scoring or screening tools are either full of ambiguity or are not valid for standard practice. BMI is a simple tool and at the same time provides an objective measurement of the nutritional status generally. But, BMI can be unreliable many a times due to complexity of disease progression with regular interruption with anti-cancer therapies. Subjective Global Assessment (SGA) tool analysis is based on medical history and clinical findings. They observe data from 7 areas under medical history and 4 areas under clinical finding topic. **(Appendix A)**. All the SGA scoring is subjective to one on one interview with patient [23].

**Appendix A: SGA tool for assessment of malnutrition. (Part A + Part B)**

**Part A**

Medical History	A	B	C
<p><b>WEIGHT</b></p> <p>Usual weight..... Current weight.....</p> <p>Wt change past 6 months      Amount weight loss..... % weight loss.....</p> <p>0-&lt;5% loss 5-10% loss &gt;10% loss</p> <p><b>Weight change past 2 weeks</b></p> <p>Amount.....</p> <p>No change; normal weight Increase to within 5% Increase (1 level above) No change, but below usual wt Increase to within 5-10% Decrease</p> <p><b>DIETARY INTAKE</b></p> <p>No change; adequate No change; inadequate</p> <p><b>Change</b>      <b>Duration of change.....</b></p> <p>Suboptimal diet Full liquid Hypocaloric liquid Starvation Intake borderline; increasing Intake borderline; decreasing Intake poor; no change Intake poor; increasing Intake poor; decreasing</p> <p><b>GASTROINTESTINAL SYMPTOMS</b></p> <p>Frequency (never, daily, no. of times/week)      Duration (&lt;2wk, &gt;2wk)</p> <p>Nausea .....</p> <p>Vomiting .....</p> <p>Diarrhoea .....</p> <p>Anorexia .....</p> <p>None; intermittent Some (daily &gt;2 week) All (daily &gt;2 week)</p>			

**Part B**

Physical Examination	A	B	C
<b>SUBCUTANEOUS FAT</b>			
<b>Under the eyes</b>	Slightly bulging area		Hollowed look, depression, dark circles
<b>Triceps</b>	Large space between fingers		Very little space between fingers, or fingers touch
<b>Biceps</b>	Large space between fingers		Very little space between fingers, or fingers touch
<b>MUSCLE WASTING</b>			
<b>Temple</b>	Well-defined muscle/flat	Slight depression	Hollowing, depression
<b>Clavicle</b>	Not visible in Males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone

<b>Shoulder</b>	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
<b>Scapula/ribs</b>	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
<b>Quadriceps</b>	Well rounded; no depressions	Mild depression	Depression; thin
<b>Calf</b>	Well developed		Thin; no muscle definition
<b>Knee</b>	Bones not prominent		Bones prominent
<b>Interosseous muscle between thumb and forefinger</b>	Muscle protrudes; could be flat in females		Flat or depressed area
<b>OEDEMA (related to malnutrition)</b>	No sign	Mild to moderate	Severe
<b>ASCITES (related to malnutrition)</b>	No sign	Mild to moderate	Severe
<b>OVERALL SGA RATING</b>	A	B	C

**Biochemical Data**

Serum Albumin level acts as one of the markers for the calculation of clinical nutritional index, but due to inflammation and cytokine-mediated acute phase response its value is generally provoked in cancer patients. Low serum albumin level in turn leads to disturbances in hormone secretion, impairment of organ function and down regulation of visceral protein synthesis. Decrease in serum albumin, pre albumin and transferrin does not always correlate directly to malnutrition instead. This could be a clinical outcome of the physiological response due to injury.

Pseudo cholinesterase (PChE) was observed to be decreased in cancer patients with malnutrition. Anorexia is a possible outcome of the reduction of PChE, which can be directly correlated to tumor. Based upon the data, Health care professionals and expert dietician provide guidance for nutrition at pre, during and post treatment stage. American Society for Parenteral and Enteral Nutrition (ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) have issued guidelines for the nutritional treatment for cancer patients.

**American Society For Parenteral And Enteral Nutrition (A.S.P.E.N.)**

The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) was founded in 1976, to improve patient care by advancing the science and practice of clinical nutrition and metabolic support. A.S.P.E.N. is an interdisciplinary organization, which is dedicated to the practice of and research in clinical nutrition and nutrition support therapy.

ASPEN comprises of health care professionals representing the disciplines of medicine, nursing, pharmacy, dietetics and nutrition science. The mission of ASPEN is to serve as a prominent, interdisciplinary, research based and patient centered

clinical nutrition society throughout the world. ASPEN vigorously works to support quality patient care, education and research in the fields of nutrition and metabolic support in all health care settings.

ASPEN Guidelines must be factually up-to-date to reflect a current, evidence-based, best approach to the practice of nutrition support.

The Guidelines must support the clinical and professional activities of nutrition support practitioners by articulating evidence-based recommendations upon which to base personal and institutional practices and resource allocation.

The Guidelines should serve as a tool to help guide policy makers, health care organizations, insurers and nutrition support professionals to improve the systems and regulations under which specialized nutrition support is administered [24].

### European Society for Clinical Nutrition and Metabolism (ESPEN)

The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines were founded in 2006. It is committed to the area of clinical nutrition and metabolism and promotes:

Basic and clinical research

Basic and advanced education

Organization of consensus statements about clinical care and care quality control

The aims of ESPEN are to encourage the rapid diffusion of knowledge and its application in the field of Parenteral and Enteral Nutrition, Clinical Nutrition and Metabolism.

### Nutrition Interaction with cancer treatment [24]

Clinical Outcome can be compromised due to malnutrition as the therapy changes the pharmacokinetic and pharmacodynamic profile of the body. Malnutrition can alter the protein binding, absorption, metabolism and renal excretion of the drug and their metabolites. In addition treatment with chemotherapy encourages alteration of the cellular immune response of normal tissue due to high rate of protein catabolism and stimulation of acute phase reactant. Due to high rate of protein catabolism, there is increase in toxicity by agents with protein binding sites like cisplatin, paclitaxel etc. Oxidative metabolism by cytochrome P-450 isoenzymes present in liver is altered due to depletion of nicotinamide adenine dinucleotide phosphate (NADP) Coenzymes. Due to impairment of this metabolic pathway in the liver, clearance of drug declines and in turn half-life of the drugs is increased. This leads to increase in toxicity.

### Nutritional Supplies for Cancer Patients

The Cancer Specific Nutritional Recommendation is applied in

three different conditions:-

When cachectic status is full-blown

When parenteral nutrition or enteral nutrition are exclusive

When nutritional support for the patients is required for several weeks

The oncologist should inform the cancer patient about the nutritional diet before, during and after the treatment [23-35].

**Table 3:** Nutritional supplements, sources and their role in cancer patients [25-35].

	Nutritional Supplements	Sources	Role of these Nutritional Supplements in Cancer Patient
1	Alkaline Diets*	Green vegetables Herbs and spices Root vegetables Onions Garlic Leek Chives Broccoli Cauliflower Cabbages	Reduces inflammation and improves intracellular pH
2	Elimination Of Sugar*	Honey Agave White Sugar High Fructose Corn Syrup	Cancer patient should avoid taking glucose (sugar) diets. High intake of Glucose leads to Cancer Proliferation.
3	Addition of non-Gluten*	Rice Buckwheat Quinoa Millet and amaranth	Reduces the risk of cancer
4	Elimination Of Gluten*	Wheat Spelt Pasta Cereals Bread Muffins Cakes Crackers cookies	Glutinous grains cause inflammation. And promote cancer progression
5	Elimination of Dairy Products*	Cow Milk Yogurt Cheese	Dairy products cause inflammation and cause bone deterioration
6	Use Of Natural Oil*	Olive Oil Coconut Oil Avocado Oil	Presence of anti inflammatory mediators , which reduce inflammation
7	Elimination of Fat Oil*	Corn Soya Canola Safflower Sunflower Oils	Increases the risk of cancer
8	Elimination of Alcoholism*	Elimination the consumption of bottled Canned or frozen fruit	Increases the risk of Alcoholic liver disease (ALD)
9	Addition of Salads*	Cabbage , carrot	Improves the red blood cells in the body

## Objectives of Nutrition Therapy

The goals of nutrition therapy for cancer patients in active treatment and recovery are intended to restore nutrient shortages, keep up nutritional health, and avert complications.

### For Recovery Stages

Prevention of Malnutrition

Maintain strength and energy

Help in recovery and healing

Maintain or improve quality of life

### For Advance Cancer

These are some goals of nutrition therapy for patients, who have advanced cancer:

Reduce Side Effects

Reduce risk of infection

Maintain strength and Energy

Improve Quality of life

### Gerson Therapy

The Gerson therapy is a powerful, natural treatment that boosts body's own immune system to heal cancer, arthritis, heart diseases, allergies, and many other degenerative diseases. It was developed by Dr. Max Gerson in the 1920s [37]. Gerson Therapy involves three basic steps:

The first step is detoxification by coffee enemas.

The second step is the Gerson Diet which supplies the essential nutrients including enzymes from 13 glasses daily of fresh vegetable and fruit juice.

The third step is the supplement of deficient nutrients, particularly potassium, iodine, and thyroid hormones [37].

### Role of Gerson Therapy in Cancer Treatment

The goal of the Gerson therapy is to restore the body wellbeing by repairing the liver and returning the metabolism to its normal state. According to Dr. Gerson, it can be done by removing toxins from the body and building up the immune system with diet and supplements. Liver is worn out due to treatment regimen which causes stress in body.

Pancreatic enzymes are administered to decrease the demands on the compromised liver. An organic diet and nutritional supplements are used to boost the immune system and support

the body, given that the course of therapy cleans up the toxin from the body. Foods, low in sodium and high in potassium, are said to help in correcting the tissue damage caused by conventional therapies.

### Diets given as per Gerson's Therapy

- Drinking 13 glasses of juice a day. The juice must be freshly made from organic fruits and vegetables and be taken once every hour.
- Eating vegetarian meals of organically grown fruits, vegetables, and whole grains.
- Taking a number of supplements, including:
  - Potassium.
  - Lugol's Solution (potassium iodide, iodine, and water).
  - Coenzyme Q10 injected with vitamin B12. (The original regimen used crude liver extract instead of coenzyme Q10.)
  - Vitamins A, C, and B3 (niacin).
  - Flaxseed oil.
  - Pancreatic enzymes.
  - Pepsin (a stomach enzyme).
- Taking coffee or chamomile enemas regularly to remove toxins from the body.
- Preparing food without salt, spices, or oils, and without using aluminum cookware or utensils [38].

### Gerson Therapy Cancer Survival Studies

"A study on 72 patients was conducted. 36 patients with Colon Cancer, which had metastasized to the liver, were placed on the Gerson Diet against 36 control patients with similar diagnosis, abstained from gerson Diet. Patients who were on Gerson diet survive more (28.6 months) in comparison to those without the gerson diet (16.2 months). Duration of treatment is unknown [39].

Five year survival rates of melanoma patients treated by diet therapy were analyzed in a retrospective study [40]. "A total of 153 patients with Melanoma cancer were treated with the Gerson Diet. All 14 early stage (I and II) patients have survival rates of 80% - 95%. In 35 patients with stage III, the survival rates of 27% to 42% ( $p=0.002$ ) were reported. In 18 patients with stage IV, the survival rate was 39%, compared to 6% to 20% in the literature ( $p<0.001$ ). Data of 53 patients was not included as they were lost to follow-up. Study was conducted by Hilden brand G / L. In Various Clinical Studies, it was estimated

that the mechanism of Gerson Therapy was yet unknown.

## Conclusion

A good nutrition plays a major role in curing Malnutrition. We have discussed various tools in this article. "Loss of weight" indicates as a poor prognostic factor in cancer Patients. Nutrition assessment tools are used to determine the prevalence of malnutrition. Protein calorie malnutrition is the inappropriate ratio of carbohydrates, proteins & fat in the body. 15 % to 25% populations were found to have anorexia & loss of appetite. Therapies like chemotherapy and radiation also cause anorexia and nausea in cancer patients. Few tools like Nutrition Risk Index and Malnutrition Universal Screening Tool (MUST) are commonly used for screening of malnutrition in cancer patients. Most frequent tool used for evaluation and screening of Malnutrition is the Subjective Global Assessment Tool Analysis (SGA). The objective of nutrition therapy is to prevent malnutrition and improve the quality of life.

An early detection of malnutrition will help a cancer patient to recover fast and maintain his QOL throughout the treatment term and after the completion of treatment also. Physicians and dieticians play a major role in identifying and guiding patient with correct treatment protocols.

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