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Impact of the Nutrition Intervention Based on Scored Patient-Generated Subjective Global Assessment (PG-SGA) and Management on the Disease Outcome in Gastrointestinal Cancer Patient in Qena

Sarah Galal Ismaeil[1], Ahmed Mohamed Mahmoud Hany[2], Eman Abdel Razek Tawfeek Abdallah[3], Gad Sayed Gad[4], Mohammed Moustafa Ali Wahman[1]

[1]*Clinical oncology and nuclear medicine department, Faculty of Medicine, South Valley University, Qena, Egypt.*
[2]*Public health and community department, Faculty of Medicine, Assiut university, Assiut, Egypt.*
[3]*Clinical oncology and nuclear medicine department, Faculty of Medicine, Menoufia University, Egypt*
[4]*Anesthesia and intensive care department, Faculty of Medicine, South Valley University, Qena, Egypt.*

Abstract: Gastrointestinal (GI) cancers, including esophageal, stomach, liver, pancreatic, and colorectal cancers, account for 26% of global cancer cases and 35% of related deaths, with 4.8 million new cases in 2018. Risk factors include lifestyle habits, infections, genetics, and chronic diseases. Poor prognosis persists due to late-stage diagnoses, except for colorectal cancer, which benefits from improved screening. Malnutrition, common in GI cancer patients, worsens outcomes, making nutritional assessment and support vital. Tools like MNA and PG-SGA help identify deficiencies and plan interventions. Micronutrients such as zinc, selenium, and copper are critical for nervous system and immune health, with advanced assessment techniques enhancing clinical care.
Keywords: Gastrointestinal Cancer, Malnutrition, Nutritional Assessment, Risk Factors, Cancer Prognosis

Introduction

Gastrointestinal (GI) cancer includes malignancies of the GI tract and exocrine digestive organs, which account for more cancer cases and deaths than any other system. Cancers of the upper GI tract include esophageal, stomach, gastrointestinal stromal tumors (GIST), and MALT lymphoma. Lower GI cancers include colon, rectal, anal, MALT lymphoma, and melanoma. Exocrine cancers involve the gallbladder, liver, and pancreas **(1)**

Causes and Risk Factors Related to Nutritional Status

Many GI cancers have idiopathic causes, but various risk factors are identified. These include excessive alcohol intake, high animal fat diets, consumption of poorly preserved foods, chronic pancreatitis, and obesity **(2).**

Esophageal Cancer

Esophageal cancer is the sixth most common cancer globally, with a male-to-female ratio of 3:1. An esophageal cancer "belt" stretches from northeastern China to northern Iran, with high incidence also noted in Ethiopia. The two main types are adenocarcinoma and squamous cell carcinoma (SCC). In developed countries, adenocarcinoma is more common. Early detection significantly improves survival rates, but most cases are diagnosed late, with a 15-20% five-year survival rate in advanced stages in the US and China **(3).**

Gastric Cancer

Gastric cancer ranks fourth in prevalence and second in cancer mortality globally. Eastern Asia has the highest incidence, while North America, Australia, and Africa have lower risks. The most common type, adenocarcinoma, causes 750,000 deaths annually. Risk factors include diet, smoking, alcohol, genetics, and infections **(4).**

Pancreatic Cancer

Pancreatic cancer is the fifth-leading cause of cancer deaths in the US and seventh in Europe. In 2008, there were 280,000 new cases globally. Risk factors include advanced age and smoking, while chronic pancreatitis and diabetes may also contribute. Pancreatic cancer has a poor prognosis, with less than 5% surviving five years post-diagnosis **(5).**

Liver Cancer

Liver cancer (hepatocellular carcinoma, HCC) is often linked to chronic Hepatitis B or C and cirrhosis from alcoholism. Symptoms may include jaundice, pruritus, or ascites. Diagnostic tools include biopsy, MRI, and CT scans. Treatment varies based on the TNM stage and cirrhosis status and may include surgical resection, ablation, or liver transplantation **(6).**

Gallbladder Cancer

Gallbladder cancer, mostly adenocarcinoma, is common in elderly women and strongly linked to gallstones and polyps. Diagnosis typically involves ultrasound, with staging by CT scan. Prognosis remains poor **(7).**

Colorectal Cancer

Colorectal cancer (CRC) is the fourth most diagnosed cancer and second-leading cause of cancer deaths in the US. In 2023, it is estimated that 106,970 new colon and 46,050 rectal cancer cases will occur, with 52,550 deaths. CRC incidence and mortality have declined due to screening and improved treatments. CRC is associated with low-fiber, high-fat diets, with hereditary syndromes contributing to early-onset cases **(8).**

Anal Cancer

Anal cancer is strongly linked to ulcerative colitis, HPV, and HIV. It may cause constipation, tenesmus, or present as a mass. Treatment options include excision, radiotherapy, and chemotherapy, with a five-year survival rate over 70% **(9).**

Gastrointestinal Carcinoid Tumor

This rare, slow-growing cancer affects cells in the stomach and intestines. Often found in the appendix, small intestine, or rectum, it is usually treated surgically **(10).**

Symptoms Affect Nutritional Status

GI cancer symptoms vary by type but commonly include abdominal pain, changes in bowel habits, rectal bleeding, bloating, nausea, weight loss, fatigue, and intestinal obstruction **(11).**

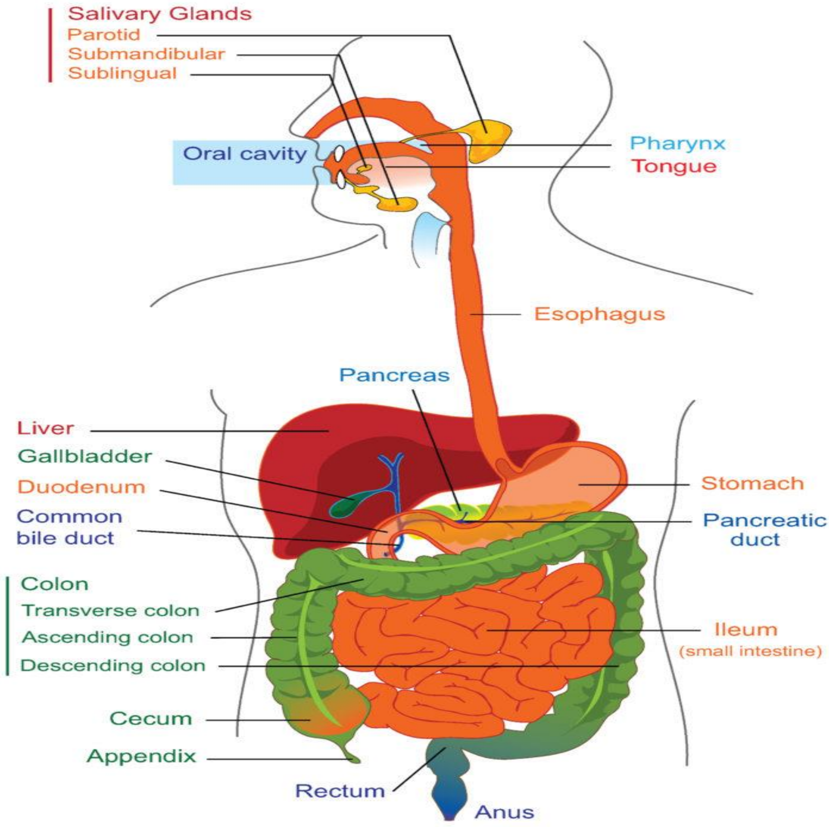

Fig (1): anatomy of the gastrointestinal tract

Epidemiology of Gastrointestinal Cancers

Gastrointestinal (GI) cancers account for 26% of global cancer cases and 35% of cancer-related deaths, with 4.8 million new cases and 3.4 million deaths reported in 2018. The most prevalent GI cancers include stomach (1.0 million cases), liver (840,000 cases), esophagus (570,000 cases), pancreas (460,000 cases), and colorectal cancer (1.8 million cases). Despite sharing some common risk factors, such as alcohol consumption, smoking, infection, diet,

and obesity, the etiology of each cancer type is distinct. More than half of GI cancers are attributed to modifiable risk factors (studies 2–7), and changes in their prevalence have been linked to temporal variations in cancer incidence (studies 8–9) **(12).**

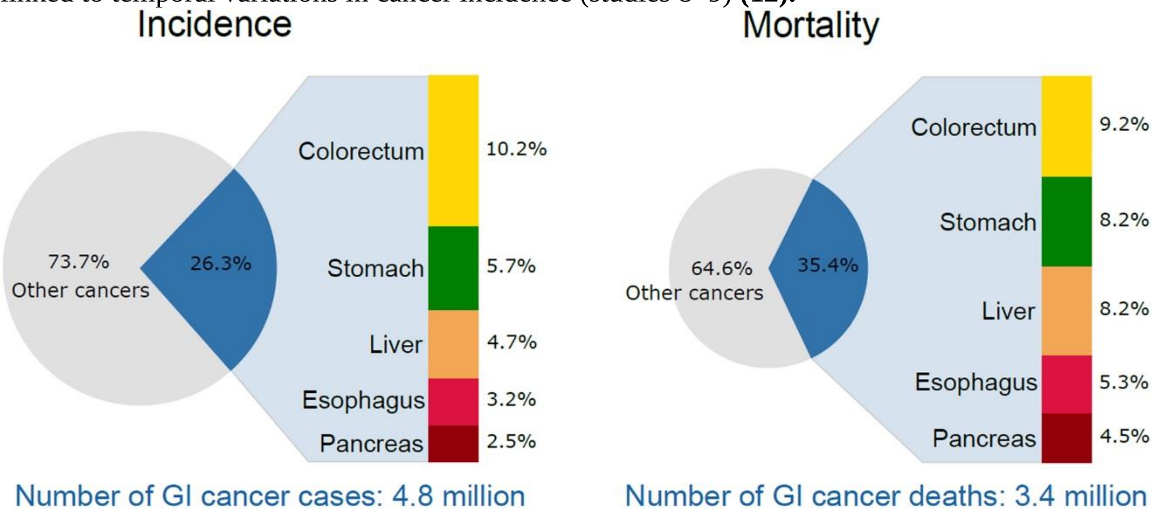

Figure 2: Contribution of major gastrointestinal cancers to global cancer cases and deaths in 2018 **(12).**

The prognosis for GI cancers is generally poor due to late-stage diagnosis, leading mortality trends to parallel incidence rates. However, colorectal cancer shows improved survival outcomes due to advances in early detection and treatment. This review discusses the global burden of major GI cancers, focusing on geographic and sex-specific incidence and mortality patterns, historical trends, associated risk factors, and future prospects for prevention and treatment impact on clinical practice **(13).**

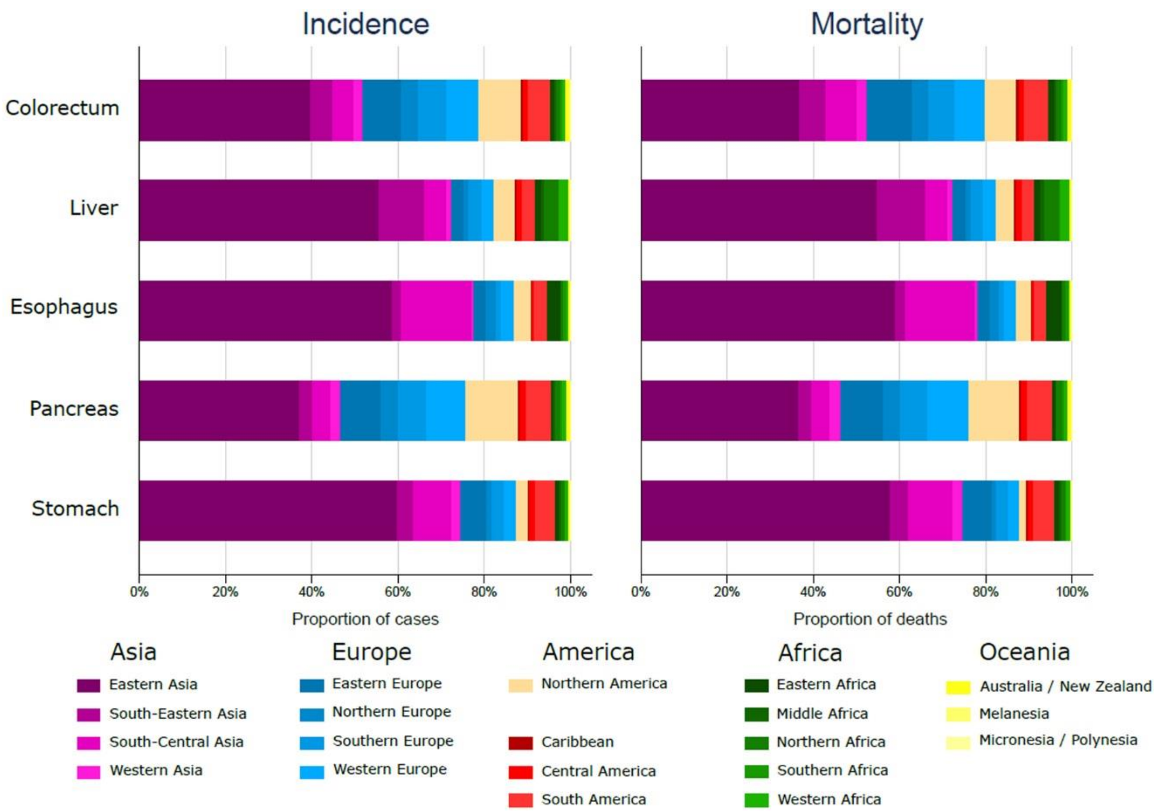

Figure 2:Distribution of new cases and deaths by world area and cancer site in 2018 **(12).**

Nutritional Status Assessment

Nutritional assessment is the process of evaluating nutritional status through dietary, laboratory, anthropometric, and clinical studies. It reflects how well the body's nutritional needs are met and is critical for identifying nutrient deficiencies, developing recommendations, and implementing public health programs to prevent nutrition-related diseases. Modern nutrition epidemiology emphasizes the need for standardized nutritional assessment methods, while socioeconomic and cultural factors must also be considered for accurate interpretation **(14).**

Nutritional Assessment Methods

There are four key nutritional assessment methods: surveys, surveillance, screening, and interventions. Nutrition surveys, typically cross-sectional, assess a population's nutritional status, identify groups at risk of malnutrition, and guide evidence-based policies. Nutritional surveillance involves continuous data collection and analysis over time to identify malnutrition risk factors and monitor public health interventions. Nutrition screening focuses on identifying malnourished individuals using simple, low-cost methods, targeting either the entire population or specific subgroups. Interventions, such as supplementation or fortification, are then applied to at-risk groups identified through surveys or screenings and require rigorous monitoring to assess their effectiveness **(15).**

Evaluation of Nutrition Interventions

There are three evaluation designs for nutrition interventions: adequacy, plausibility, and probability evaluations. Adequacy evaluation measures outcomes against predefined goals for an entire population. Plausibility evaluation uses quasi-experimental designs with non-randomized groups and multivariate analysis to reduce bias, while probability evaluation employs randomized, controlled, double-blind trials, offering the highest confidence in results **(16).**

General Aspects and Systems of Nutritional Assessment

Nutritional assessments aim to detect deficiencies, evaluate diet quality, and predict health outcomes. Historically, nutrition assessments evolved from studies of livestock to large-scale surveys in developing countries, eventually becoming critical in patient care and public health. The three main systems of assessment—nutrition surveys, surveillance, and screening—continue to be fundamental in both population studies and clinical settings **(17).**

Methods of Nutritional Assessment

Nutritional assessment methods are categorized into five main types. **Dietary assessment** estimates nutrient intake through tools like food frequency questionnaires, diet histories, and food records. **Anthropometric assessment** evaluates nutritional status using physical measurements such as body dimensions and composition. **Clinical assessment** involves medical history and physical examination to detect signs of malnutrition, including both visible signs and symptoms reported by the patient. **Biochemical assessment** measures nutrient levels and metabolic functions to gauge nutritional status. Lastly, **sociologic assessment** considers factors such as socioeconomic status, food availability, and practices, which influence nutrition **(18).**

Nutritional assessment often combines these methods to provide a comprehensive evaluation. For example, assessing adults may involve medical history, physical examination, and lab tests, along with anthropometric data and functional assessments. No single variable can fully capture an individual's nutritional status in every situation. Poor nutritional status, marked by factors like body protein levels below 80% or more than 10% unintentional weight loss, has been linked to increased morbidity and prolonged hospital stays **(19).**

Assessment and Biomarkers

A systematic review of seven studies demonstrated a significant link between nutritional assessment scores and albumin levels, further emphasizing the importance of biochemical markers in elderly patients. Additionally, individualized nutrition plans, based on detailed assessments and risk screenings, improve outcomes for hospitalized patients **(20).**

Dietary Assessment Validity

A systematic review of 29 studies involving 6,298 adults found significant underreporting of energy intake (EI) compared to total energy expenditure (TEE) ($P < 0.05$), highlighting the need for accurate dietary assessments in chronic disease research. Comprehensive nutritional assessment starts with a medical history that includes diagnoses, medication, appetite, weight changes, and food availability. Weight loss remains one of the most validated indicators of nutritional status **(21).**

Physical Examination

Following the medical history, a physical examination should focus on soft-tissue wasting, hydration, and signs of nutrient deficiencies. Common markers include height, weight, and

BMI, which provide essential insights into the individual's overall nutritional health **(22).**

Anthropometric Measures

Height and Weight

Height is best measured using a stadiometer but can be estimated through arm span or knee height if the individual cannot stand. Weight should be measured with the individual standing, shoes and overgarments removed, with serial measurements useful for tracking weight changes over time. Weight loss sustained over 6 months is categorized as mild (< 5%), moderate (5%-10%), or severe (>10%), with severe loss linked to poor health outcomes and prolonged hospital stays **(24).**

Body Mass Index (BMI)

The relationship between weight and height, expressed as BMI, is a widely used anthropometric measure. The National Institutes of Health defines BMI categories as underweight (< 18.5), desirable (18.5-24.9), overweight (25-29.9), and obese (≥30). BMI can be calculated as weight in kilograms divided by height in meters squared or weight in pounds multiplied by 703, divided by height in inches squared **(25).**

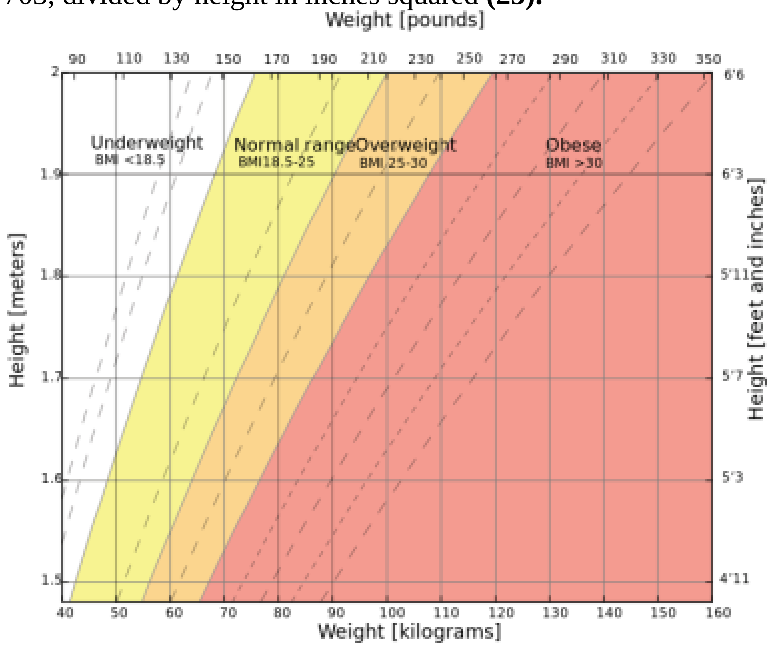

Fig (2) : BMI graph.

Skinfold Thickness Measurement

Skinfold thickness is an indirect method to assess subcutaneous fat using calipers at various body sites. Based on these measurements, body density, and percentage of body fat can be estimated using equations by Durnin and Womersley or Jackson and Pollock. Common equations for estimating body fat include those by Siri and Brozek. Accuracy depends on the operator's skill and declines with plastic calipers and increased obesity **(26).**

Skinfold Sites and Procedure: Common measurement sites include the triceps, chest, subscapular, abdomen, supra iliac, and thigh. Measurements should be taken on the right side of the body with calipers placed 1 cm from the pinch, perpendicular to the skinfold, and read within 1-2 seconds. Retests are recommended if readings differ by more than 1-2 mm **(27).**
Body Density and Fat Estimation: Body density can be calculated using the 3-site formula from Jackson and Pollock, specific to males (chest, abdomen, thigh) and females (triceps, suprailiac, thigh). The Siri and Brozek equations convert body density to percentage body fat. The Siri equation estimates body fat as (495/body density) **-** 450, while Brozek's formula is (457/body density) **-** 414.2 **(28).**

Fig (3)Tricep skinfold thickness measurement with plastic calipers. Courtesy of the CDC.

Fig (4) Subscapular skinfold thickness measurement with plastic calipers. Courtesy of the CDC.

Mid-Arm Muscle Circumference and Area

Mid-arm muscle circumference (MAMC) is a reliable measure of muscle protein reserves, commonly used alongside triceps skinfold measurements to calculate mid-upper-arm muscle area, which reflects lean body mass. These measures are simple to perform and correlate with mortality, particularly in older adults and patients with cirrhosis. To obtain MAMC, the upper-arm length is measured from the scapular spine to the olecranon process, with the arm bent at 90°, and the midpoint marked for circumference measurement. The subject should stand evenly balanced while measurements are taken **(29).**

Circumference measurement is taken with a measuring tape placed perpendicular to the arm at the marked midpoint. Triceps skinfold should be measured at the same location. Once both measurements are obtained, mid-upper-arm muscle area is calculated using the following equations: for men, Area (cm^2) = ([arm circumference – {π x triceps skinfold}]^2/4π) - 10; for women, Area (cm^2) = ([arm circumference – {π x triceps skinfold}]^2/4π) - 6.5. Standards for upper-arm muscle area are based on National Health and Nutrition Examination Survey (NHANES) data **(30).**

A study analyzed 12 anthropometric measurements from 780 adults, reducing them to a Composite Score (C). This C score was compared with BMI and Mid-Upper Arm Circumference (MUAC) for nutritional assessment. The study found that 45.9% of subjects were undernourished by BMI, 56.7% by MUAC, and 51.8% by the C score. The C score provided a higher correct classification rate (98.7%) compared to BMI (95.9%) and MUAC (96.2%) **(31).**

Nutrition Screening Tools

Mini-Nutritional Assessment (MNA)

Developed in 1989, the Mini-Nutritional Assessment (MNA) evaluates nutritional status in elderly patients (>65 years) and is widely used in clinical practice. It includes two forms: the full MNA and the short-form (MNA-SF). The full MNA consists of four sections—anthropometrics, general assessment, dietary assessment, and subjective assessment—with a maximum score of 30. Nutritional status is categorized as "well-nourished" (score ≥24), "at risk for malnutrition" (17-23.9), or "malnourished" (<17) **(32).**

The MNA-SF, now preferred for all elderly patients, includes a screening step with 6 items and a maximum score of 14, followed by a further assessment for those at risk or malnourished. Scores ≥12 indicate satisfactory nutrition; scores 8-11 suggest risk of malnutrition; and scores ≤7 indicate malnutrition **(33).**

In a study of 1,003 elderly patients, the MNA-SF detected frailty with a sensitivity of 71.2% and specificity of 92.8% for frail patients, and 45.7% and 78.3% for pre-frail patients. Of the patients, 22% of those classified as frail were malnourished, and 49.2% were at risk; 1.6% of pre-frail patients were malnourished, and 25.1% were at risk **(34).**

Effect of Early Nutritional Support on Clinical Outcomes

The EFFORT trial investigated the impact of early nutritional support on frailty, functional outcomes, and recovery in malnourished medical inpatients at eight Swiss hospitals. Patients at nutritional risk (NRS 2002 score ≥ 3) with an expected hospital stay longer than 4 days were included. The trial randomized 2,088 patients into two groups: 1,050 received protocol-guided individualized nutritional support aimed at meeting protein and caloric goals, while 1,038 received standard hospital food. The intervention group achieved caloric and protein goals in 79% and 76% of patients, respectively **(35).**

After 30 days, 23% of the intervention group and 27% of the control group experienced adverse clinical outcomes (adjusted odds ratio [OR] 0.79 [95% CI 0.64–0.97], p=0.023). Mortality rates were 7% in the intervention group compared to 10% in the control group. The study concluded that individualized nutritional support significantly improved clinical outcomes, including survival, compared to standard hospital food **(35).**

Advanced Body Composition Analysis

Advanced techniques for body composition assessment include dual-energy X-ray absorptiometry (DEXA), underwater weighing, air displacement plethysmography (ADP), and bioelectrical impedance analysis (BIA). These methods provide comprehensive insights into body fat, lean mass, and bone density **(36).**

Functional Measure of Nutrition Status: Fist-Grip Dynamometry

Fist-grip dynamometry (FGD) is a validated measure of nutritional status, reflecting muscle function impairment in malnourished individuals. A handheld dynamometer assesses maximal hand-grip strength, which correlates with total body protein. In surgical patients, grip strength ≤85% of age- and sex-corrected norms doubles the risk of perioperative complications. The accuracy of FGD depends on factors like wrist and forearm position, elbow flexion, posture, and measurement protocol. The American Society of Hand Therapists (ASHT) recommends performing FGD with the subject seated, shoulders adducted, elbow at 90°, and using an adjustable dynamometer to accommodate various hand sizes. According to the Southampton protocol, three trials on each hand are conducted, with the highest measurement compared to age- and sex-adjusted standards **(37).**

Laboratory Medicine Summary

Serum proteins such as albumin, transferrin, prealbumin, and retinol-binding protein are widely used to assess nutritional status. These hepatically produced negative acute-phase reactants decrease during systemic inflammation, but their low levels are strongly indicative of malnutrition in the absence of inflammation **(38).**

Patient-Generated Subjective Global Assessment (PG-SGA)

The Scored Patient-Generated Subjective Global Assessment (PG-SGA©) is a comprehensive tool used for assessing nutritional status in oncology and chronic conditions. It integrates patient-generated components—weight history, food intake, symptoms, and functional status—with professional assessments including diagnosis, age, metabolic stress, and physical examination. Nutritional status is categorized into "well-nourished" (grade A), "mild-moderate malnutrition" (grade B), or "severe malnutrition" (grade C), based on total numerical scores and triage recommendations **(39).**

Functional and Physical Examination

The PG-SGA© includes a detailed physical examination, focusing on malnutrition signs such as subcutaneous fat loss, muscle wasting, edema, and ascites, graded from “none” to “severe.” This examination, although not mandatory, provides valuable insights and complements the patient-generated data. Scores from weight history and symptoms are additive, while those from food intake and functional status are not. The examination helps distinguish between anabolic and catabolic states, assessing recent weight changes and their implications for nutritional status **(40).**

Professional Component and Interpretation

The professional component of the PG-SGA©, completed by clinicians, involves evaluating disease stage, metabolic stress factors, and physical symptoms. This component adds minimal time to the assessment and provides a deeper understanding of the patient's condition. The PG-SGA numerical score, derived from both patient and professional inputs, offers precise guidelines for medical nutrition therapy, while the categorical A, B, or C ratings provide a general overview of nutritional status. A higher numerical score often indicates more severe malnutrition, but the correlation between numerical scores and categorical ratings can vary depending on intervention and follow-up results **(41).**

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