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Nutrition in Rehabilitation

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NUTRITION IN REHABILITATION

by

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This Independent Study, submitted by John D. Haywood, Jr., in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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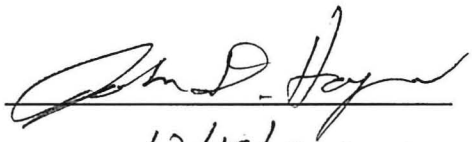
Signature 

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ABSTRACT

Diet has been implicated as a risk factor in atherosclerotic cardiovascular diseases, cancer, diabetes, osteoporosis, obesity, high blood pressure and chronic liver and kidney diseases. These diseases include almost all of the most common non-traumatic causes of death in the United States. It has been suggested that many physicians do not have the opportunity for specific training in nutrition while in medical school. Many studies have shown that patients admitted to a hospital are at risk of malnutrition and that this risk will increase as length of hospital stay increases. Other studies suggested nutritional deficiencies may result in delayed wound healing, major and minor complications, and increased mortality. These complications increase length of stay and hospital costs. A physical therapist, as part of a team, has the chance to impart basic nutritional information to patients. This information may be in addition to information provided to the patient by a physician, nurse, dietician or other health care worker. Patients with improved nutrition benefit from disease prevention through elimination of this risk factor. Patients with improved nutrition also benefit directly from increased energy to participate in physical therapy. This paper will be a review of the literature on the topics of prevalence of malnutrition in hospitals, physician education in nutrition, and nutrition in wound healing to summarize recent findings. From these findings, conclusions concerning nutrition in rehabilitation and recommendations for physical therapists will be provided.

CHAPTER 1

INTRODUCTION

Rehabilitation is healing. Viewed holistically, it involves everything from the cellular level to aspects such as emotion and attitude. Rehabilitation also includes external factors such as social and/or environmental factors. Like rehabilitation, nutrition is a subject that can be researched at the cellular level, the system level, and holistically when lifestyle and preventative measures are considered. During all phases of rehabilitation, the nutritional status of a patient is an important consideration. Research in nutrition and rehabilitation has increased at all levels during the last two decades.

The diet of Americans has been implicated as a risk factor in several major diseases.[1] Nutritional deficiencies are also directly related to specific diseases or conditions. Measurements of protein and caloric requirements for hospital inpatients show that a surgical patient has increased needs compared to an uncomplicated medical patient.[2] Hypercatabolic patients, such as patients with severe burns, have even greater nutritional requirements than surgical patients. Severe burn patients are examples of the relationship between nutrition and health for several reasons. Burn patients are among those with the highest protein and caloric needs and have greatly increased requirements for

fluids and electrolytes. In addition, they have elevated requirements for vitamins and minerals, without which the healing process would be delayed or halted.[3] Nutritional status may also affect the immune system which, if compromised, can increase complications of a patient in rehabilitation.

Given this relationship between nutrition and health, it might be expected that nutrition in the hospital is a primary concern of hospital staff and administration. An average citizen probably thinks the hospital is an unlikely place to find their nutritional status in danger. In reality, the prevalence of malnutrition in hospital inpatients is much larger than in the community, even when compared with poor rural or urban counties.[4] Regardless of whether or not a patient is malnourished at the time of admittance, he is more likely than not to worsen over the course of his stay.[5] There has been increased attention to the prevalence of hospital malnutrition since a well-publicized article helped to expose the problem in 1974. Butterworth's[6] "Skeleton in the Hospital Closet" surprised many people and stimulated much research. The prevalence of malnutrition is now well documented,[7-9] and possible causes have been suggested and researched.[5,6] Various methods of assessment of nutritional status have been validated and compared.[10-12]

Because good nutrition is needed for healing and health maintenance, the prevalence of malnutrition can be expected to have an impact on health care costs.[13,14] Delayed healing and increased risk of infection or other complications would tend to increase the length of stay and thus directly increase

costs. The relationship between a patient's nutritional status and various outcomes has been researched and is still studied frequently at this time. How nutritional status affects morbidity and mortality, complications, hospital costs, and hospital length of stay (LOS) is being explored.[15-18] These cost and outcome measures have also been studied to look at the effects of nutritional intervention during a hospital stay.[19-22] There is current controversy concerning the cost-effectiveness of various nutritional support therapies.

Patients may expect the physician, as the leader of a health care rehabilitation team, to be highly knowledgeable about nutrition. In actuality, many physicians have limited access to education in nutrition during their early training.[23] Concerned individuals, physician groups, and governmental agencies have suggested, over the last 30 years, that nutrition education might be inadequate.[24-26] Many suggestions for required courses in medical school basic curriculum have been made. One recommendation for a required course in nutrition was made by the American Medical Association (AMA) council on food and nutrition which met in 1960.[24] This council reconvened in 1962 and 1972 and noted a complete lack of progress in its goal of increasing nutrition education in medical curricula. Only approximately one-fourth of medical schools now have required courses in nutrition.[27]

The purpose of this paper is to review the literature concerning the prevalence of malnutrition, the effects of nutrition and malnutrition on healing

and final outcomes, and physician education in nutrition. The following issues will be addressed:

1) The prevalence of malnutrition in the hospital.

2) Change in a patient's nutritional status during a hospital stay.

3) Nutrients necessary to wound healing and the prevention of complications.

4) Nutritional status effects on the length of stay and total costs.

5) Nutritional intervention and support effects on outcomes and total costs.

6) Availability of nutrition education for physicians.

7) Barriers to including nutrition education in medical school curricula.

8) Our responsibility as health care workers, and particularly as physical therapists, to a patient's nutritional concerns and a patient's overall rehabilitation.

Literature concerning these stated issues will be reviewed and conclusions drawn based on the quantity and strength of the literature for each issue. Directions for future research and recommendations will be discussed.

CHAPTER 2

DEFINITION AND DETECTION OF MALNUTRITION

Malnutrition is assessed and defined in various ways. Nutrients include all food, fluids, electrolytes, vitamins, and minerals that are required by the body for normal functioning and health.[28] Malnutrition may be generally defined as a deficiency of a nutrient or nutrients that has led or may lead to a specific deficiency disease, complication, or decrease in health status. This definition of malnutrition is often made in terms of the measures of nutritional status taken by a health care worker. When these measures of nutritional status are lower than normal, they may only indicate a patient at risk and not a patient who is starving.

A general term often used is "protein-energy malnutrition" (PEM). This term defines a combination of low total caloric intake and low protein intake and refers to a common nutritional deficiency.[28] The term "undernourished" is sometimes used by researchers to describe decreased nutritional status and usually implies a risk of problems rather than an advanced state of malnourishment.[29] An accurate term used with increasing frequency is the "likelihood of malnutrition" (LOM).[30] This identifies persons with low nutritional parameters and may be used with a score or index to identify patients with

greater or lesser risk of future health problems. The way malnutrition is often defined, it may not be a specific entity or disease state. It may be defined within each study by the parameters the researchers choose to use to measure a patients nutritional status.[8,10] These parameters may indicate risk of malnutrition, LOM, or risk of related complications rather than specifically identifying a disease called "malnutrition."

Individuals must be assessed before malnutrition can be detected. The methods of assessing nutritional status may be divided into three categories: laboratory tests of biochemical indicators, anthropometric measurements, and observations from clinical evaluation.[28] In a review of numerous articles, counting lab tests and anthropometric measurements, at least fourteen different indicators have been measured that show some relationship to nutritional status.[8,28,30]

There is a widespread effect of nutrients on the processes of every cell. Deficiencies of a nutrient or various nutrients will result in various deleterious conditions or effects. For this reason, there is no single, individual test that will specifically detect malnutrition.

The way a researcher defines malnutrition and the way it is assessed may affect the sensitivity of the detection of malnutrition. Researchers will often use a combination of parameters in their assessments. As will be seen in the following section, the way a researcher defines and assesses malnutrition will affect the

prevalence of malnutrition that is reported. The measures of nutritional status most frequently used in the studies reviewed are summarized in Table 1.

Of the laboratory tests, assessment of serum albumin levels is a commonly used measure of protein status in a patient. This measure was especially common in early studies, but has been criticized due to the long half-life of albumin.[29,31] Albumin can stay in the bloodstream for many days; thus, its measurement may not reflect the most current protein status in the body. The level of serum transferrin is also used to measure protein utilization by the body but has a shorter half-life than albumin. This makes serum transferrin a more accurate measure of protein status in an individual. Either hematocrit or hemoglobin assessment can indirectly relate to nutritional status by indicating a deficiency of iron.[32] Other biochemical indicators such as total lymphocyte count are directly related to immune function, and, if decreased, may be an early indicator of poor nutritional status.

Most of the biochemical indicators measured in laboratory tests have a wide range of values considered normal.[32] The wide range decreases the sensitivity of any one test and the chance that it will detect malnourishment in a patient. This is a reason why more than one measure is usually considered when making a diagnosis.

Anthropometric measures are those that measure body shape, size, lean body mass, or body fat percentage.[32] In the assessment of malnutrition,

TABLE 1. Common indicators used to assess nutritional status[8,32,34]

Laboratory Tests	
Total Protein	measurements of protein
Serum Albumin	
Serum Transferrin	
Hematocrit	indirect measurements of iron
Hemoglobin	
Creatinin-Height Index	
Plasma Folate	measurement of specific vitamins
Plasma Ascorbate	
Total Lymphocyte Count	measurements of immune function
Delayed Skin Hypersensitivity	
Anthropometric Measurements	
Weight for Height	
Body Mass Index (BMI)	
weight in kilograms divided by (height in meters)^2	
Arm Muscle Circumference	used to estimate lean body mass
Triceps Skin fold	
Subscapular Skin fold	
Clinical Evaluation	
Percent of body weight lost recently	
Observation:	
muscle wasting	
skin	dry or dehydrated
eyes	dull or clouded
hair	dull, dyspigmented, easily plucked
gums	bleeding or receding
tongue	purple or swollen

anthropometric measurements account for half of the parameters used in the majority of studies reviewed here.

Historically, measurement of body weight has had somewhat consistent use in hospitals in this country.[33] Measurement of body weight is generally used as a baseline to detect large weight losses that may occur during a hospital stay. If height is measured, weight-for-height proportions can be looked up to assess normalcy. Body Mass Index (BMI) is calculated by dividing body weight in kilograms by the squared value of the height in meters.[33] This has been shown to correlate with body fat percentage better than weight for height measurements.[33]

Arm muscle circumference is often used in conjunction with triceps skin fold measurement to get an estimate of lean body mass. This estimate should take into account bone content in a cross-section of the upper humerus.[32]

Anthropometric measurements have a moderate to high degree of reliability[11] and validity.[12] They correlate well with laboratory tests as measures of nutritional status.[7] Triceps skin fold measurement is sensitive for detection of malnutrition but BMI may require a huge weight loss before it would detect certain malnourished individuals. In comparison with lab tests, anthropometric measurements are inexpensive and can be performed by any health care worker who is sufficiently trained.

Clinical evaluation is the third category of nutritional assessment. It usually involves both a history and specific physical observations. Baker[34] found

that clinical evaluation for malnutrition has both inter-observer and inter-tester reliability. Baker also found that clinical evaluation correlated well with measurement of serum albumin for detection of malnourished patients. Muscle wasting is a common description used by physicians evaluating such patients.

Malnutrition may be best viewed as a continuum. Low nutritional intake can lead to loss of energy, muscle wasting, and increased risk of deficiency diseases, infection, or other complications.[35,36] Although malnourishment is not usually the primary reason a patient is admitted to the hospital, recognition of malnutrition, however it is defined, is necessary for optimal healing and rehabilitation.

CHAPTER 3

PREVALENCE OF HOSPITAL MALNUTRITION

Historically, the problem of hospital malnutrition was generally ignored. Malnutrition was often not detected until a patient's condition reached life-threatening levels.[6] Today, it still may not be a primary concern, as it is usually a secondary complication to the disease or trauma for which patient was admitted. In 1974, Butterworth[6] documented several cases of hospital staff-induced or physician-induced malnutrition in the infamous article, "The skeleton in the hospital closet." This article, quoted frequently in literature throughout the last twenty years, stimulated research in nutrition and malnutrition that continues today.

Bistrian[7] found a rate of approximately 50% malnutrition among general surgical patients. In this study, serum albumin levels were measured in one sample of patients and in another sample, arm muscle circumference and triceps skin fold were measured. Bistrian found the correlation between serum albumin levels and anthropometric measures of malnutrition to be highly significant. In addition, Bistrian called attention to problems resulting when a measure of weight for height is the only assessment of nutritional status. Most obvious of

these was that obese patients who have severe depletion of lean body mass will not be detected by this method. In addition, this measure is not sensitive to moderate amounts of weight loss. In a subsequent study, Bistrian[37] measured weight/height ratio, triceps skin fold, arm-muscle circumference, serum albumin, and hematocrit in general medical patients. Using these five parameters, the incidence of malnutrition found ranged from a low of 44% (when serum albumin was considered) to a high of 76% (when triceps skin fold was measured). Bistrian did not report numbers of patients with two or more below-normal variables. The simultaneous consideration of multiple variables may make the assessment more specific to detection of malnutrition.

Hill[9] reviewed records of all inpatients and found that patients still in the hospital one week after surgery had the highest incidence of malnutrition, defined as two or more below-normal parameters. In a subsequent, comprehensive study, Mullen et al[38] measured twelve different variables and found that 97% of all patients had at least one abnormal measurement and 35% had at least three abnormal measurements. Mullen and associates found that the most accurate predictors of morbidity and mortality were serum albumin, serum transferrin, and delayed cutaneous hypersensitivity. these findings of high rates of malnourished patients concur with findings of similar studies.[7,8,9,28,38]

Weinsier et al[5] were the first researchers reviewed by this author who tested patients when admitted and again two weeks later. These authors measured eight different nutritional status indicators and compiled a LOM score

for each patient. they found 48% of patients with high LOM upon admittance. Of this 48%, 69% had a higher LOM two weeks later. Similarly, 75% of patients with normal parameters when admitted fell below normal during the two-week period. Coates et al[30] replicated this study using the same general design at the same hospital, twelve years later. Coats and associates identified patients with high LOM at admittance and found 38%, as compared with 48% in Weinsier's study. Two weeks later the number of patients with high LOM scores was 46%, as compared with 62% in the first study. This replication demonstrated that nutritional status still tends to decrease during a hospital stay but no longer as dramatically as in the earlier study.

Kamath and associates[39] completed a retrospective study of 3,047 patients at thirty-three Chicago-area hospitals to study the incidence of malnutrition. Malnutrition rates of approximately 40% to 58% were found. Sixty-one percent of patients had had less than three measures of nutritional status taken. Several patients had had no assessment of nutritional status recorded. The information gathered for this study was taken mostly from lab reports or nurses' notes, since a formal nutritional screen or assessment was not generally done. In this study, Kamath et al. argued that if no early nutritional screen is done, there will be no baseline for comparisons of subsequent assessments. Low parameters in subsequent tests may be reported, but will not be seen to relate to poor nutritional status. Consequently, if this connection is missed, the chance for nutritional intervention is very low. In addition to the malnutrition

findings, the authors proposed a model system for health care workers to provide nutritional screening. They estimated that a 150-bed hospital could nutritionally screen all patients with one dietitian and one technical support person.

Aoun et al[8] measured eight parameters in 100 consecutive patients. He found the rates of malnutrition to be 81%, 65%, 53%, and 31% if one, two, three, or four abnormal parameters, respectively, are used to assess malnutrition. Aoun and associates stated that a combination of parameters increases specificity, and any three abnormal parameters, present simultaneously, would define malnutrition. Based on three abnormal parameters, he reported a patient malnutrition rate of 53%.

McWhirter and Pennington[29] used BMI as the main assessment measure and found that 40% of 500 new admits were undernourished. This was defined as a BMI below 20. They reported that BMI was a specific measure of nutritional status and superior to any single biochemical indicator. In addition, it was found that no nutritional information had been documented in 48% of the 200 undernourished patients.

The body requires many nutrients, and these nutrients impact every system in the body. For this reason no single measure will accurately determine nutritional status.[8] Although there is no single test to determine nutritional status, multiple measures may be taken.[31] Anthropometric measurements and laboratory tests correlate well with each other and with clinical evaluation of malnutrition in patients.[7,34] Many of the measurements taken routinely in a blood

test, such as hematocrit and total lymphocyte count, relate to nutritional status[10] and should be examined and considered as measures of a patient's nutritional status. With early detection it may be possible to avoid complications related to malnutrition.

CHAPTER 4

CAUSES AND CONSEQUENCES OF MALNUTRITION

Many factors affect a patient's intake of nutrients while in the hospital. If intake is low, a patient may be assessed and found at risk for malnutrition. Malnutrition has been associated with poor wound healing, increased morbidity and mortality, increased incidence of pressure sores, increased length of stay, and increased hospital costs.[13,14,22,40,41] This chapter will be divided into three sections to examine nutritional needs and intake, specific nutrient contributions to wound healing, and the deleterious effects of poor nutritional status.

Factors in nutritional needs and intake in the hospital

The energy needs of a person afflicted by trauma or disease are elevated when compared to those of a healthy individual. Protein and caloric requirements for a hypercatabolic patient (one suffering from severe trauma or burns) can be three to four times those of an uncomplicated medical patient.[42] The body can adapt to short-term increased needs for protein by catabolizing muscle tissue. If intake of protein is not elevated to meet the demand, a noticeable and potentially dangerous drop in lean body mass can result.[6] In addition to protein and total calories, the body stressed by surgery, trauma, or

disease has increased requirements for vitamins, minerals, fluids, and electrolytes.[35] Some of the vitamin and mineral requirements for such individuals can be many times the recommended dietary allowance (RDA) of a healthy individual.[43] Although all of the essential nutrients are required for normal body functioning, certain nutrients in particular have been proven crucial to wound healing, immunocompetence, and other aspects of healing and rehabilitation. A short summary of nutrients with strong effects on wound healing and immune response is provided in Table 2.

At a time of increased need, a hospital inpatient may have several different factors contributing to a decreased intake of food and nutrients.[32,44] Pre-admission nutritional status can be affected by financial, emotional, and social factors as well as medical conditions or medications affecting appetite or absorption of nutrients. Once under hospital care, a patient may be restricted from oral intake (NPO) for numerous reasons. One to three days of NPO is common for performance of diagnostic tests and procedures on the patient. If a patient is scheduled for surgery, another one to two days of NPO is usually necessary. During the post-surgery period, a patient may not tolerate regular meals. A patient's discomfort as well as his medication status may not be conducive to oral intake. These and other factors contribute to decreased nutritional status while in the hospital. Although they are recognized, these

TABLE 2. Specific nutrient effects on wound healing and immune response[35,44,47,52]

Vitamin C	- collagen synthesis - collagen deposition - collagen tensile strength
Vitamin A	- collagen content and strength in cutaneous wounds - enhancement of the inflammatory phase of wound healing - counteracts deleterious effects of glucocorticoids on wounds - helps immune response through fibroblast differentiation
Iron	- DNA synthesis required for all cell proliferation at wound site - needed for oxygen carrying capacity of the blood
Zinc	- anti-bacterial action on skin - RNA and DNA enzyme synthesis - decrease in wound healing time
Protein	- controls length of inflammatory phase of wound healing
Arginine (amino acid)	- stimulates T-cell development - stimulates lymphocyte proliferation
Glutamine (amino acid)	- fuel for macrophages at wound site - mediates protein metabolism and may decrease muscle wasting in the body's effort to provide protein

factors are not completely avoidable because of our current reliance on diagnostic and surgical procedures as well as modern medications.

Patients who are healing at home are affected by some of the factors that contribute to poor nutritional intake. Stotts[41] found that 16 of 19 patients with open wounds who were recovering at home had insufficient nutritional intake to support healing. Ten patients in the same group had less than the RDA of protein and all had decreased vitamin C and zinc intake.

In summary, a patient usually has increased nutritional needs and decreased nutritional intake while in the hospital. Researchers have recommended that some type of nutritional assessment be performed on all patients.[6,10,39] Screening for patients with a high risk of malnutrition is often recommended at the time of admittance to a hospital or long-term care facility. Periodic reassessment at regular intervals is useful, especially when a patient has previous baseline values available for comparison. Nutritional assessments can identify patients at risk and help health care workers avoid potentially dangerous and costly complications.[14]

Specific nutrient effects on healing

When patients with increased caloric needs are identified, these patients usually require even higher percentages of protein in their diet.[2] In other words, protein requirements will take up a greater percentage of the total calories required. Protein status is often measured indirectly with anthropometric measurements that estimate lean body mass. In lab testing, serum albumin and

serum transferrin are specific for protein. Some clinical signs presented by a patient with severely depleted protein stores are dry skin, peripheral edema, and muscle wasting. Protein is needed for collagen synthesis, lymphocyte formation, and cell-mediated responses in inflammation. The inflammatory phase has been shown to be prolonged in a patient with protein depletion.[45] In extreme cases, protein may be catabolized from nearby tissue in a burn wound or pressure ulcer, which can result in an increase in wound size.[43]

Ascorbic acid (Vitamin C) is another nutrient without which wound healing cannot occur.[44] In addition, long term deprivation causes scurvy. Scurvy is rare in the United States but has been detected with increasing frequency among the institutionalized elderly.[46] In healing, vitamin C is required for collagen synthesis and for immune system reaction to infection. Its presence can decrease the time spent in the inflammatory phase of wound healing by fighting oxidation and free radical formation. Second to zinc, it is the most highly implicated depleted nutrient in wounds where healing is delayed or absent. For inpatients undergoing surgery or experiencing trauma, it can be utilized in amounts ten to fifteen times greater than the RDA.[43] It is also needed in higher amounts in cancer patients, elderly patients, and smokers. There is controversy surrounding mega-doses of vitamin C and its purported risks and benefits, and no definite conclusion has been reached[50]; however, it has been shown that there is little risk from a daily dose of 30 times the RDA.[51]

Twenty percent of the body's zinc is stored in the skin.[52] Zinc in the skin has the effect of inhibiting bacteria growth, especially when a break in the skin occurs. It is necessary for immune response and DNA/RNA synthesis and cell proliferation, and without it, lymphocytes are unable to divide and differentiate. In spite of its importance, the average intake of zinc in the United States is below the RDA.[44] Zinc depletion affects nutritional intake in different ways. It is needed for appetite regulation and its depletion can lower taste acuity, which may indirectly affect appetite and voluntary intake.[52] Zinc deficiency has been linked to anorexia nervosa, but it is still unclear whether the deficiency contributes to the disease or the disease contributes to the deficiency. Hallbook and Lanner[53] completed one of the most often cited studies regarding zinc and found that patients low in zinc had improved venous leg ulcer healing with zinc supplementation.

Iron is known to be important in wound healing.[2] It is necessary for DNA synthesis, hemoglobin and oxygen transport, collagen synthesis, and stimulation of bactericidal activity of leukocytes. Iron sufficiency can be assessed indirectly through hemoglobin or hematocrit tests or directly through serum iron. Clinical signs of deficiency include those for anemia: fatigue, pallor, and brittle nails. Like zinc, iron has been implicated in appetite disorders--an important factor to consider when trying to reverse malnutrition.

Protein, zinc, vitamin C and iron are nutrients whose importance to wound healing has strong scientific support.[2,35,36,44,52] Other nutrients contribute to

physiological function and overall health. This author will review whole body effects of malnutrition as well as associated costs in the following section.

Costs and effects of malnutrition

Once the prevalence of malnutrition in the hospital was noted (see Chapter 3), researchers studied malnutrition as a possible predictor of complications, morbidity and mortality.[10,13,54] Then clinical researchers began calculating the cost.[13,14,18] Researchers studied malnutrition as it relates to increased LOS, because this factor will escalate costs for a hospital inpatient.[55,56] Methods of treatment that may decrease complications in a malnourished patient are still being studied. Treatments that cannot be shown to be cost-effective have less chance of continued use.

Many of the following studies were conducted as retrospective reviews of patient records. This design works well for identifying relationships between variables but can not show a causal link between the variables.[57] In a retrospective look at 500 consecutive general hospital admissions, Seltzer and associates[10] studied simple nutritional parameters and their relationship to morbidity and mortality. The two commonly measured parameters were serum albumin and total lymphocyte count. Seltzer et al referred to these parameters as an "instant nutritional assessment". Both measurements significantly correlated with an increase in complications and deaths. Low serum albumin (< 3.5 g/l) was associated with a four-fold increase in complications and a six-fold increase in deaths when compared with normals. High total lymphocyte count

was associated with a two-fold increase in complications and a four-fold increase in deaths.

Reilly et al[13] studied 771 patients in a retrospective review of LOM as it related to costs and complications. Using serum albumin, total lymphocytes, and height for weight, malnutrition was found in 48% of patients. High LOM patients demonstrated a longer mean stay in every DRG. These patients were 3.4 times as likely to have a predefined minor or major complication and were 3.8 times more likely to die when compared with normally nourished inpatients.

Wunderlich and Tobias[55] reviewed the hospital records of 163 patients with diverticulosis or diverticulitis in terms of LOS and correlated this with previously measured nutritional assessment parameters to look for a relationship. The authors proposed that a close relationship would give predicative power to the assessment factors implicated. It was found that women who stayed approximately twenty days showed serum albumin levels below 30 g/l, while levels above 30 g/l correlated with an eleven-day LOS. Hemoglobin also correlated with LOS: patients with depleted levels stayed approximately sixteen days as compared with ten days for normal levels. The authors stated that serum albumin levels and hemoglobin levels could be used to identify patients at risk and to predict patients who may required a prolonged stay.

A fourth retrospective study examined 245 patients post-G-I surgery.[16] Malnourished patients' LOS was 23.5 days as compared with 16.5 days for

normal patients. When these patients were divided into groups based on whether or not nutritional support was provided, a significantly increased LOS was found for patients who received nutritional support (either total parenteral nutrition, TPN, or peripheral parenteral nutrition, PPN, see Table 3). One reason proposed for this increased LOS was that the time necessary to provide the nutritional support treatment varied from six to eleven days. Another reason was that patients who required nutritional support tended to be in worse condition than other patients.

In a prospective research design, patients can be assessed initially and then followed to study the relationship between the initial assessment and outcomes. Robinson[18] audited 100 new admissions, measured their nutritional status, and followed the patients for LOS and hospital charges. The patients were considered malnourished if they had recent weight loss greater than 10% or if they had three or more abnormal parameters and obvious signs of malnutrition during a physical examination. Parameters included both anthropometric measurements and laboratory data. Patients were classified into their diagnostic related groups (DRG's) and costs were compared. The malnourished patient incurred costs of $16,991 as compared with $7,692 for the normal patients. The LOS was significantly longer for the malnourished patients, at 15.6 days compared with 10 days for the normal group. Robinson suggested that early recognition of malnutrition and aggressive treatment may lead to decreased costs and LOS.

In a second prospective study, Patterson et al[56] reviewed sixty-three elderly hip-fracture patients whose nutritional status was measured on admission. Four laboratory tests were used and outcomes were examined in terms of development of complications, LOS, and morbidity. Fifty-eight percent of the patients were determined to be in a protein-depleted state by the lab tests. This depleted group had more complications, increased LOS, and decreased probability of survival one year post-fracture. Patterson et al suggested nutritional intervention in the post-operative period.

The influence of nutrition on the healing of pressure sores has received much attention in scientific journals.[17,40,58] It has been theorized that in addition to the impairment of wound healing, lack of certain nutrients can actually contribute to a breakdown of skin tissue. Berlowitz[40], in a prospective study, identified risk factors associated with the presence of a pressure sore and risk factors associated with the development of a new sore. Both decreased nutritional intake and decreased serum albumin were significantly associated with the presence of a sore. Decreased nutritional intake was also associated with the development of a new sore. In a subsequent study, Bergstrom[58] found dietary intake of protein was a significant predictor of pressure sore development in newly admitted nursing home residents.

Pinchcofsky-Devin[54] found both decreased food intake and malnutrition were associated with pressure ulcers. Protein and general nutritional status are shown to relate to pressure sore development in the above studies, but studies

have not clearly demonstrated the same relationship for specific vitamin and mineral deficiencies, although both zinc and vitamin C have been shown necessary for healing.[36,52] Further studies examining specific nutrients have been recommended.

Building on this information, an experimental study was conducted in which patients with ulcers were broken into groups and fed formulas containing either 24% or 14% protein.[17] The patients consuming the 24% protein formula showed a significant decrease in ulcer surface area while the patients on a 14% protein diet did not show a significant decrease.

Although the studies mentioned above do point to a relationship between poor nutritional status and complications and/or LOS, the cost-effectiveness of *providing* nutritional support has not been demonstrated in all cases.[14,59] It has been suggested that aggressive enteral or parenteral nutritional support be provided only to specific patient populations or patients identified to be at risk.[59] Methods of nutritional support and effects of nutritional intervention will be reviewed and will be summarized in the following chapter.

CHAPTER 5

NUTRITIONAL SUPPORT AND ITS EFFECTS

When a patient's loss of lean body mass causes him to enter starvation mode, his life is threatened and the costs associated with recovery will be increased significantly. Nutritional recovery syndrome refers to the slow re-feeding process a patient who is starving must undergo.[32] If a patient is re-fed too quickly, dangerous shifts in electrolyte balance can cause fatal heart problems. Patients in this condition may spend weeks in the hospital, including several days in intensive care for close monitoring, as the patient is progressed through the feeding levels (See Table 3). Aggressive nutritional intervention or support early in a hospital stay has been suggested as a remedy for the malnutrition detected in previous studies. Although the cost-effectiveness of this is still under study, numerous methods are available for current use.

Nutritional Support

Nutritional intervention usually involves an initial assessment followed by delivery of nutrients to the patient. The patient will always be fed at the most progressive level of tolerance. Oral intake is normal eating accompanied by voluntary swallowing. It could include solid food or liquids based on patient

TABLE 3. Common methods of nutritional support[28,48]

Oral

- Supervision or assistance with normal diet (solid)
- Liquid nutritional supplements
- Varied consistency diets

Enteral

- Nasoenteric tube feeding (NG)
  - naso-gastric
  - naso-duodenal
  - naso-jejeunal
- Percutaneous endoscopic gastrostomy (PEG)

Parenteral

- Fluid IV supplemented with:
  - glucose
  - electrolytes
  - vitamins and minerals
- Total Parenteral Nutrition (TPN)
  - central
  - peripheral

Education

- Diet assessment
- Risk factor education
- Nutritional counseling
  - education
  - menu planning
  - psych/social consult

tolerance. Enteral nutrition refers to nutrients entering through the gastro-intestinal (G-I) tract and absorbed in the normal manner. It is usually used to signify some type of delivery that does not involve voluntary swallowing. A nasogastric (NG) tube can be fed into the stomach, duodenum, or jejunum. A percutaneous endoscopic gastrostomy (PEG) tube is fed directly into the stomach or small intestine.

Parenteral nutrition refers to nutrients fed directly into the bloodstream, bypassing the G-I tract. It is most commonly used post G-I surgery or where a patient may have impaired ability to absorb nutrients through the digestive tract. Total parenteral nutrition (TPN) refers to complete nutrition. Peripheral parenteral nutrition (PPN) refers to entry into a peripheral vein, while TPN can be a peripheral vein or a central line near the heart.

Obvious factors involved in the choice of delivery include a patient,s ability to chew, swallow, digest, or absorb nutrients through the digestive tract as well as the specific deficiencies the patient may demonstrate through laboratory assessment.[34] Whether a patient is obese or needs increased lean body mass are factors. A patient's susceptibility to infection may influence the mode of delivery. Nutritional support may involve a dietician,s consult, assessment and reassessment, and nutritional counseling, menu planning, and continuing education.

Effects of Nutritional Support

As the prevalence of malnutrition and the deleterious effects of malnutrition have been shown in the studies reviewed above, studies that examined effects of treatment on outcomes were also reviewed. Three of these studies used a retrospective design. It should be noted that an experimental design is not always possible because of the ethical implications of withholding nutritional support after a patient with low nutritional status has been identified.[15]

Garrel and associates[22] studied post-operative burn patients with or without early enteral nutritional support. In this nonexperimental study, these researchers found that patients fed in the first five days after surgery (mean 3, range 1-5) stayed fewer days than patients fed in the second five days (mean 7, range 5-9). The difference in LOS was 38.8 days for the early-fed group compared with 75.8 days for the later-fed group. In addition, this LOS correlated with the patient's energy intake. Garrel and associates suggested a randomized clinical trial with a similar design be completed to determine if these LOS results could be replicated. Nyswonger and Helmchen[21], in a retrospective study, examined early feeding of stroke patients. The times involved were similar to the Garrel study. Nyswonger and Helmchen compared patients fed before or after 72 hours of admission and found a difference in LOS of 9.62 days in support of early feeding.

A study with true experimental design randomized abdominal trauma patients and divided them into enteral or parenteral feeding groups[49]. Both

groups were fed within 24 hours of injury. The group fed enterally had significant fewer infections. This group also had significantly fewer infections when all infections relating to the administration of parenteral nutrition were eliminated from consideration. This statistical significance was higher for the most severely injured patients.

Eisenberg et al[59] conducted an expensive large-scale experimental study to determine if TPN given before and after surgery decreased total costs of care. In addition to total costs, the researchers studied the frequency of major and minor complications. These surgical patients were assigned to groups that did or did not receive TPN for an average of seven days pre-op and three days post-op. The average cost of delivering this care was $3,200. The difference in number of complications as compared with controls did not achieve significance. Eisenberg et al calculated the cost of avoiding complications and reported that $14,000 was spent per complication avoided. Although the total number of complications was lower for the TPN group, infections related to TPN administration were prevalent. A large part of the increased costs calculated came from the increased time spent in the hospital to deliver the TPN. These authors proposed further research to determine which patient populations may benefit most and thus demonstrate increased cost-effectiveness of the procedure.

A recent study randomized intensive-care unit patients and examined outcomes for two types of formulas fed to the patients.[20] The design was a

double-blind clinical trial. The difference in formulas was the addition of arginine, nucleotides, and fish oils to the experimental formula. The significance of these additions was their reputed effect on the immune system. All three substances have been implicated in recent research as enhancing immunocompetence.[36] The difference in LOS was significantly lower for the experimental group.

Researchers[18,39] with studies reviewed in this paper who demonstrated high prevalence rates of hospital malnutrition often suggested nutritional support may cure the problem. Research has not yet shown all the expected benefits of providing nutritional support, but further research may provide additional defense for this treatment.

CHAPTER 6

NUTRITION EDUCATION FOR PHYSICIANS

For more than thirty years, there have been recommendations from various groups to increase requirements for medical school education in nutrition.[24,25,26] The lack of nutrition education for physicians has been noted publicly as early as 1960. In that year, the AMA Council on Foods and Nutrition criticized medical schools, stating nutrition was receiving inadequate recognition, support, and attention in medical education.[24] The Council's report included a recommendation for an increase in hours devoted to teaching nutrition. The AMA Council reconvened in 1962 and 1972, and participants noted a lack of progress and restated their recommendations.

In 1969, the White House Conference on Food, Nutrition and Health resulted in a statement of concern over the paucity of medical school education in nutrition and cited Senate subcommittee testimony on that subject.[25] In 1985, the National Academy of Science, National Research Council (NAS-NRC) recommended a minimum of 25 hours of nutrition education in a separate course.[60] At that time, only two schools were found to have met that criteria. Subsequently, the American Society of Clinical Nutrition published standards for nutrition in medical school curricula.[23] In addition to similar recommendations

from Congress and various physicians' professional organizations, the American Medical Students Association stated[61]:

> Generally, patients should be able to expect physicians to have at least a minimum level of knowledge and skill in the area of nutrition.... Unfortunately, very few physicians have this level of expertise, and if they do, it has been generally acquired outside the traditional medical school curriculum.

In a pre-graduation test and survey of medical students from 10 different schools, there was significant variation in nutrition knowledge levels.[62] Eighty-five percent of these seniors were dissatisfied with the quantity of their medical nutrition education. The knowledge scores correlated negatively with the dissatisfaction with an r value of .35.

In 1974, as mentioned previously in this paper, physicians brought the problem of hospital malnutrition to the attention of the medical community through their publications.[6,7] In the studies reviewed documenting prevalence of malnutrition, lack of physician education was usually listed as a contributor to this problem.[5,6,7,37]

Since the mid-1970's, the percentage of medical schools with a required course in nutrition has not changed substantially.[27] In 1992, only 24% of medical schools had a required course in nutrition. From 1974 to 1992, the percentage of schools with elective courses in nutrition dropped from 82% to 70%.

Although 70% of medical schools have elective courses, many physicians who would benefit from a course may not have the opportunity to enroll. There is an increasing trend toward specialization in medical education. As the medical student chooses an area of interest and enters the fourth year, the elective courses relate to that specialty area.[26] Nutrition as an elective course is recommended or required in maternal and child health, epidemiology, endocrinology and metabolism, and family medicine. This leaves many practitioners such as the general surgeon or the internal medicine specialist without this early and influential opportunity for education in nutrition. All practitioners, especially office-based general practitioners and internal medicine specialists, have patients who would benefit from the physician's expertise, or will suffer from the lack thereof.

As stated earlier, the majority of groups making recommendations felt that nutrition was best introduced into the basic curriculum as a required course. In additional to Congress, professional organizations, and medical students, a survey of practicing physicians also demonstrated support for education in nutrition. In a large-scale study[63] of office-based primary care physicians, 68% of the respondents rated the nutrition education they had received in school as inadequate; 77% stated they wished they had been taught more nutrition in medical school; and 86% indicated more nutrition should be taught as part of the basic curriculum.

Some of the reports on the status of medical school nutrition education listed possible barriers to nutrition education in the curriculum and physician practice of nutrition. Summarized here are seven important barriers: [23,26,64]

1) Nutrition is not considered a science by academic physicians.

2) There is a lack of PhD-level nutrition faculty at medical schools.

3) Medical school departments are reluctant to give up hours.

4) Medical school administrators feel nutrition is covered adequately in other courses.

5) Nutrition is not covered on the medical board examinations.

6) There is little insurance reimbursement for nutritional counseling.

7) Physicians are not comfortable with intervention that will require behavioral change.

The barriers to nutrition education result from a number of factors.[23,26,64] These barriers may come from administration and department personnel trying to protect their "turf". Some of these barriers are a result of attitudes, opinions, and a general resistance to change and do not lend themselves to objective study. Despite this, the barriers appear real and are plausible explanations for the lack of progress in nutritional education curricula.

Lack of separate nutrition departments in medical schools and university teaching hospitals is one contributing factor.[26] When nutrition is not considered a hard science or a separate discipline, nutritional discoveries will be credited to other disciplines. Winick[23] provided some examples of these nutritional discoveries including: the effect of vitamin A on the retina is credited to

biochemistry, the theory of receptor sites for lipoproteins is credited to genetics, the immunological properties of breast milk is considered pediatrics. These examples support the conclusion that nutrition is a science, although the basic discoveries tend to be credited to other medical fields.

The lack of nutrition questions on the medical board examinations is also a contributing factor.[65] Medical schools instruct students in a manner that will enable the majority of them to pass the boards. The board exams have no separate section on nutrition and when individual questions were examined, less than three percent were related in any way to nutrition.

There is ample identification of the paucity of required instruction in most medical schools. Numerous governmental, private physician, and concerned citizen groups have shown concern over this issue. Numerous barriers have also been identified. The barriers to implementation of some of the recommendations may be barriers to change in general.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS FOR PHYSICAL THERAPISTS

In the definition and detection of malnutrition, this author noticed little controversy over the terms used or methods chosen to assess malnutrition. One possible reason for this lack of controversy is that little danger would result from a false-positive diagnosis. If a patient with a single low value from a laboratory measurement was wrongly labeled malnourished, the consequences of this label may be limited to close monitoring by health care workers, additional tests taken, or specific dietary recommendations. Any of these three actions would not harm a normal individual as they have preventative as well as restorative value.

Nearly every author reviewed in this paper was more concerned with the lack of detection of malnutrition than with over-aggressive assessment techniques. Specifically, the ease of nutritional assessment was emphasized[10] as well as the potential for cost savings that would result from early detection of malnutrition.[14]

As the number of nutritional assessment measurements taken increases, the likelihood that one will be abnormal also increases.[8] Researchers variously defined malnutrition as the presence of one to four abnormal parameters.[7,8,66] The most common measures chosen in the studies reviewed by this author were

serum albumin and triceps skin fold. If only a single laboratory measure is taken, a measure of protein status such as serum transferrin would be recommended, based on its support in the literature reviewed here. If a single anthropometric measure is taken, an estimate of lean-body mass based on upper arm circumference and triceps skin fold may be recommended based on this literature review. These single measures relate to PEM, the most common nutritional deficiency disorder.[28] The health care worker should remember that each test measures a specific nutrient or condition and that a nutritional status assessment is the whole-body assessment implied by the results of these individual tests.

Nutritional support may be simply education and dietary recommendations or may be as involved as TPN provided through a central vein. This author found greater support for enteral nutrition than parenteral, when medically appropriate, because it is safer, less expensive, and better tolerated by patients.[32,48,49,59] The cost effectiveness of parenteral nutrition for all G-I surgery candidates has been reviewed, with results showing some support.[59] Eisenberg et al[59] found that complications not relating to the administration of TPN could be avoided through TPN at a cost of almost $14,000 per complication avoided. This cost is high, but possibly not prohibitive. More research in this area is recommended. New research shows support for enteral formulas that may promote healing.[17,20] The cost of providing enteral formulas and especially parenteral nutrition should decrease as its use becomes more widespread.

There may not be a clear assignment of responsibility for nutritional concerns at certain facilities, but these concerns should not be ignored. Registered dieticians are knowledgeable about nutritional education, assessment, and support, but usually cannot act without the direction of a physician. The physician, as a leader of a health care team, needs to take some responsibility for a patient's nutritional status.[64]

Concern over the lack of nutrition education for physicians has been shown and barriers have been identified. Although less than half of American medical schools have required courses in nutrition,[27] the number of students choosing nutrition as a specialty is increasing.[63]

Although assignment of responsibility for nutritional concerns should be done by any facility handling inpatients or residents, these concerns should be a shared responsibility. Rather than delegating this duty, the physical therapist should recognize that the patient will benefit by receiving nutrition education from multiple health care workers. This repetition may reinforce the importance of these issues in the mind of the individual concerned.

A physical therapist should recognize the clinical signs and symptoms of malnutrition. In addition, some general knowledge of the biochemical indicators of malnutrition would facilitate a therapist's interpretation of a patient's medical chart. When evaluating a patient's response to treatment, a therapist must realize that a decrease in energy output will result from muscle and liver glycogen depletion after missing two to three consecutive meals.[28] If the

therapist questions the patient on recent food intake, fatigue from glycogen depletion can be differentiated from neuromuscular fatigue.

Although not measured in any of the studies reviewed by this author, awareness of the problem of hospital malnutrition has probably increased during 20 years of research and publicity. Despite this, malnutrition prevalence rates have shown only slight decreases in the 20-year period reviewed by this author. Four particular studies[8,13,29,37] of the prevalence of hospital malnutrition spanning 19 years all demonstrated similar rates.

This suggests that some aspects of hospital malnutrition may be unavoidable due to factors this author mentions in Chapter 4. The NPO order required for most testing and surgical procedures undergone by a hospital inpatient may be a contributing factor, as may trauma and medication effects on appetite. The physical therapist cannot effectively evaluate musculoskeletal function without some consideration of nutritional status and the fuel that allows for muscle contraction and movement.

When considering the consequences of malnutrition, those of particular concern to the physical therapist include its effects on wound healing and the relationship of pressure sores to protein depletion. Because of the increased nutritional needs of burn patients mentioned in chapters one and four, the therapist practicing daily debridement has a responsibility to provide education to the patient. With the exception of the emergency room physician, the therapist may be the only health care worker with frequent patient contact during the

crucial healing period. The physical therapist can encourage the patient to eat well, increasing protein and caloric intake as well as fluid, electrolyte, iron, zinc, and vitamin C intake.[2] The benefits to the patient could include a decrease in healing time and a decreased chance of scarring.[36]

Avoidance of pressure sores may be another benefit of a normal nutritional status.[17,40,54] Pressure sores can devastate the quality of life of the victim and are particular risks of the institutionalized elderly. The physical therapist may have frequent patient contact and can relate to clients the importance of good nutrition.

One final aspect of nutrition not covered in this paper, but worthy of mention, is the relationship of diet to the diseases most common in this country. Five or six of the largest killers of Americans include diet as a risk factor.[1] Specifically, a diet high in saturated fat and low in fiber has been directly related to atherosclerosis, heart diseases, and many cancers. Diet, as well as sedentary lifestyle, are two risk factors that are easily modified with the help of a concerned therapist. A physical therapist has the chance to educate clients in health prevention and health promotion practices that this author feels will prove to be of increasing importance in the future.

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