

ASSESSMENT OF NUTRITIONAL STATUS IN A POPULATION OF RECENTLY HOSPITALIZED PATIENTS

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Abstract Malnutrition in the hospital is not a new or rare problem, however, it is often unrecognized. In order to determine the baseline nutritional characteristics of recently hospitalized patients, we assessed the nutritional status of all medical in-patients between April and December 1994 in a large hospital in the province of Buenos Aires. One hundred and seventy patients were derived from the Internal Medicine ward and 176 patients from the General Surgery ward. Surgery patients were younger (median: 46 years vs 58 years of the Medicine patients). Among Medicine patients, cardiovascular and respiratory afflictions were the most common (30%), while gastrointestinal disorders were more often seen in Surgical patients (71%). A weight loss of more than 10% (%WL) was found in 12% of the Medicine and Surgery patients and a body mass index (BMI) of less than 19 kg/m² was observed in about 5% of both groups. Ten percent of the Medicine patients and 14% of the Surgery patients were overweight. A mid-upper arm muscle circumference (MUAMC) less than the fifth percentile was found in 11% of the Medicine patients but in only 3% of the Surgery patients. These results suggest that this population of recently hospitalized patients is at high-risk for medical complications. Therefore, early nutrition assessment and appropriate nutrition intervention are required to improve clinical outcome and help reduce the cost of health care.

Resumen *Evaluación del estado nutricional de una población de pacientes recientemente hospitalizados.*

La malnutrición hospitalaria no es un problema nuevo o infrecuente, sin embargo es comunmente no diagnosticada. Con el objetivo de determinar las características nutricionales basales de pacientes recientemente hospitalizados, evaluamos la composición nutricional de todos los pacientes internados entre abril y diciembre de 1994 en un hospital de la Provincia de Buenos Aires. La muestra consistió en 170 pacientes internados en Clínica Médica y 176 en Cirugía General. Los pacientes quirúrgicos eran más jóvenes (mediana: 46 años vs 58 años de los pacientes de Clínica). Entre los pacientes de Clínica, las afecciones cardiorespiratorias fueron las más frecuentes (30%), en tanto que trastornos gastrointestinales fueron más comunes entre los pacientes quirúrgicos (71%). Una pérdida de peso de más de 10% se halló en 12% de los pacientes de Clínica y Cirugía, y un índice de masa corporal de menos de 19 kg/m² fue observado en cerca del 5% de ambos grupos. Diez por ciento de los pacientes de Clínica y 14% de los quirúrgicos tenían sobrepeso. Una circunferencia muscular braquial menor al quinto percentilo fue hallada en 11% de los pacientes de Clínica pero sólo en 3% de los pacientes quirúrgicos. Estos resultados sugieren que esta población de pacientes recientemente hospitalizados está en alto riesgo de complicaciones médicas. Por lo tanto, la evaluación e intervención nutricional tempranas son necesarias para mejorar el cuadro clínico y reducir los costos de salud.

Key words: hospital-related malnutrition, serum albumin, weight/height ratio

It is a well known fact that the prevalence of malnutrition in hospitalized patients, especially among surgical ones, is high.¹⁻⁷ Malnutrition occurs when the intake and/or absorption of nutrients is less than the metabolic requirements so that an impairment of physiological function results.⁸ Since nutritional status is an important

factor influencing clinical outcome, early recognition and treatment of malnourished patients may reduce the incidence of pre- and post-operative complications; morbidity and mortality; and the patient's cost per day and length of hospital admission.⁹⁻¹⁵ It is thus beneficial both for quality of care and for economic reasons to detect and treat malnutrition.⁸

Anthropometric measurements are widely used in the assessment of nutritional status, particularly when an imbalance between intakes of protein and energy occurs. Such disturbances modify the patterns of physical growth and the relative proportions of the body tissue such as fat, muscle, and total body water.¹⁶ Clinically important

Received: 5-VI-1997

Accepted: 13-VIII-1997

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malnutrition is also frequently diagnosed if serum albumin level is less than 3.5 g/dl, total lymphocyte count is less than 1800 mm³, or body weight has involuntarily decreased more than 15%.¹⁷

Recently, Nightingale et al.⁸ assessed the nutritional status of eighty-four in-patients at the Leicester Royal Infirmary (Leicester, England). They concluded that using percentage weight loss (%WL), body mass index (BMI), and mid-upper arm muscle circumference (MUAMC), the prevalence of malnutrition on their general medical ward was 35%. Only 28% of the malnourished patients had been diagnosed as such by a dietitian.

Malnutrition acquired in the hospital setting remains a serious problem around the world.¹⁸ In Argentina, data to substantiate this assertion are scarce. In order to determine fluctuations of body weight during the time of hospitalization, it is necessary to have a baseline measurement at entry. The purpose of this work was four-fold: (1) to estimate prospectively the nutritional status of newly hospitalized patients in a hospital of the province of Buenos Aires, (2) to identify the prevalence of malnutrition and obesity in patients hospitalized in the Medicine and Surgery wards of this hospital, (3) to determine whether there are significant nutritional differences between the two groups of inpatients, and (4) to assess whether %WL, BMI, and MUAMC are reliable measurements for the identification of malnourished patients in this population.

Patients and methods

Patients

All hospitalized patients seen at the Internal Medicine and General Surgery clinics of the Hospital General de Agudos Mario V. Larrain (city of Berisso, province of Buenos Aires, Argentina) between April and December 1994, were entered in the study. Three hundred and forty-six patients were assessed (170 from the Internal Medicine ward and 176 from the General Surgery ward). Procedures were in accordance with guidelines provided by the Hospital Ethics Committee.

Measurements

Patients underwent nutritional assessment within 72 hours of admission. Weight, height, triceps skinfold thickness (TSF) and mid-upper arm circumference (MUAC) were measured. Calculations for percentage weight loss (%WL), body mass index (BMI), and mid-upper arm muscle circumference (MUAMC) were performed as follows:

$$\%WL = \frac{\text{previous weight (kg)} - \text{current weight (kg)}}{\text{previous weight (kg)}} \times 100$$

$$BMI \text{ (kg/m}^2\text{)} = \frac{\text{current weight (kg)}}{\text{height (m)}^2}$$

$$MUAMC \text{ (cm)} = MUAC \text{ (cm)} - [3.14 \times TSF \text{ (cm)}]$$

Previous weight was defined as the usual weight during the previous year. The MUAC (the mid-way between the tip of the acromion and olecranon processes) and the TSF measurements were carried out by one observer on the relaxed non-

dominant arm. MUAC values were obtained using a non-extensible tape measure and TSF values were measured using Lange skinfold calipers. The average of three measurements was computed for both MUAC and TSF.

Aliquots of serum were obtained and stored at -20°C until analysis. Serum albumin determinations were made using a spectrophotometric method based on the binding of bromocresol to albumin. Hemoglobin and total lymphocyte measurements were carried out by the hospital laboratory using standard Coulter counter methods.

Statistical analysis

Differences between Medicine and Surgery patients were assessed via the chi-square test (for categorical variables) and the Mann-Whitney test (for continuous variables). Normality was investigated using Royston's extension of the Shapiro-Wilk *W* test.¹⁹⁻²⁰ Where necessary, the data were transformed logarithmically to normalize their distributions. Sex-adjusted partial correlation coefficients were obtained following Theil's method.²¹ Multiple linear regression was performed to investigate which variables (e.g., age, TS, MUAC, WC, and sex) might contribute to BMI. All analysis were performed using STATA statistical software.²²

Results

Baseline group characteristics

Over the 9-month study, 346 patients were admitted to the hospital and constituted the study population. On admission to the hospital, or up to 72 hours after admission, 170 patients (49.1%) were hospitalized in the Internal Medicine ward and 176 patients (50.9%) were hospitalized in the General Surgery ward. Baseline characteristics for the study population are presented in Table 1.

The male to female ratio reflects the proportion of beds available for each sex rather than the sex ratio and the morbidity in the general population. Participants were predominantly middle-aged, although the age range was wide (14-95 for Medicine patients, 15-83 for Surgery patients). Medicine patients were older (median, Medicine patients: 58 years, Surgery patients: 46 years; $p < 0.001$). The skewed proportion of gastrointestinal patients admitted for surgery (71% of all surgical patients) is a reflection of the expertise of the surgeons of this hospital in performing laparoscopic cholecystectomies. This observation is also consistent with the shorter hospital stay for Surgery patients when contrasted to Medicine patients (Surgery participants, median hospital stay: 7 days, range 1 - 67; Medicine patients, median: 9 days, range 1-83; $p = 0.0175$).

Baseline nutritional characteristics of the Medicine and Surgery patients are reported in Table 2. Body mass index ($p < 0.05$), triceps skinfold thickness ($p < 0.05$), mid-upper arm circumference ($p < 0.001$), mid-upper arm muscle circumference ($p < 0.001$), and albumin ($p < 0.001$) were all significantly greater in Surgery patients compared to Medicine patients. Current weight was higher than ideal

TABLE 1.— *Baseline characteristics of Medicine and Surgery ward patients*

| | Medicine Patients (n = 170) | | Surgery Patients (n = 176) | |
|----------------------------|--------------------------------|------|-------------------------------|------|
| | n | %* | n | % |
| <i>Sex</i> | | | | |
| Male | 103 | 60.6 | 97 | 55.1 |
| Female | 67 | 39.4 | 79 | 44.9 |
| <i>Age</i> | | | | |
| < 25 | 14 | 8.2 | 22 | 12.5 |
| 25-39 | 24 | 14.1 | 47 | 26.7 |
| 40-49 | 24 | 14.1 | 32 | 18.1 |
| 50-59 | 26 | 15.3 | 36 | 20.5 |
| 60-69 | 27 | 15.9 | 27 | 15.3 |
| 70+ | 55 | 32.4 | 12 | 6.8 |
| <i>Type of Disorder</i> | | | | |
| Gastrointestinal | 21 | 12.4 | 125 | 71.0 |
| Neurologic | 7 | 4.1 | - | - |
| Urologic | 14 | 8.2 | 14 | 8.0 |
| Cardiovascular-Respiratory | 51 | 30.0 | 5 | 2.8 |
| Infectious | 25 | 14.7 | - | - |
| Endocrinologic | 14 | 8.2 | 4 | 2.3 |
| Psychiatric | 10 | 5.9 | - | - |
| Traumatologic | 11 | 6.5 | 10 | 5.7 |
| Hematologic | 6 | 3.5 | 4 | 2.3 |
| Rheumatologic | 3 | 1.8 | - | - |
| Dermatologic | 8 | 4.7 | 1 | 0.6 |
| Other | 6 | 3.5 | 13 | 7.4 |

* Percentages do not sum up to 100 because of rounding.

by 10.4% for Medicine subjects and by 14.3% for Surgery subjects. This excess of body weight was also identified using BMI, which categorized both groups as "slightly overweight" with "acceptable but not desirable" weight.²³

The average anthropometric data and serum albumin, hemoglobin, and total lymphocytes are consistent with good nutritional status. However, 27 Medicine patients (16%) presented a BMI above 30 kg/m² (obese), while 51 surgery patients (29%) were above that level. The difference in BMI between these two groups was not statistically significant. Eight Medicine (5%) and 10 Surgery (6%) patients were considered malnourished (BMI < 19 kg/m²). In both groups, a modest average decrease in body weight, about 3%, was experienced in the previous year. Twenty-one patients (12%) in each group, however, had lost more than 10 percent of their weight. A MUAMC less than the 5th percentile and within

the reference age range²⁴ detected 18 Medicine (11%) and 5 Surgery (3%) patients to be malnourished.

When patients with diagnosed forms of cancer were compared to non-cancer patients, only TS ($p = 0.01$) and hemoglobin ($p = 0.0005$) were significantly higher in the latter. Current weight, BMI, UAC, UAMC, WC, and total lymphocytes were not significantly different between one group and the other.

BMI correlations

The sex-adjusted partial correlation coefficients for body mass index versus other selected variables are shown in table 3. In both groups, body mass index increased with current body weight, triceps skinfold thickness, mid-upper arm circumference, mid-upper arm muscle circumference, wrist circumference, and hemoglobin.

TABLE 2.- Comparison of nutritional status in Medicine and Surgery ward patients

| | Medicine Patients (n = 170) | | Surgery Patients (n = 176) | |
|--|--------------------------------|-----------------|-------------------------------|-------|
| | Mean | SD ^a | Mean | SD |
| Current body weight (kg) | 71.1 | 18.0 | 72.6 | 15.1 |
| Ideal Absolute weight (kg) | 64.1 | 7.0 | 63.6 | 7.3 |
| Deviation from Ideal Weight (%) | + 10.4 ^b | | + 14.3 | |
| Usual Weight (kg) | 73.9 | 17.0 | 74.9 | 15.5 |
| Deviation from Usual Weight (%) | -3.3 | | -3.5 | |
| Height (cm) | 165.1 | 9.9 | 164.6 | 10.1 |
| Body Mass Index (kg/m ²) | 26.5 | 5.9 | 26.8 | 5.2 |
| Triceps skinfold thickness (cm) | 14.9 | 16.3 | 16.9 * | 16.2 |
| Mid-upper Arm circumference (cm) | 26.9 | 4.5 | 28.9 ** | 3.8 |
| Mid-upper Arm Muscle Circumference (cm) | 22.2 | 3.7 | 23.6 ** | 3.4 |
| Wrist Circumference (cm) | 16.8 | 1.8 | 16.9 | 1.9 |
| Body size | 9.9 | 0.8 | 9.9 | 0.9 |
| Albumin | 3.6 | 0.6 | 3.8 ^c | 0.5 |
| Hemoglobin | 13.2 | 2.7 | 13.5 | 2.1 |
| Total Lymphocytes | 1876.3 | 756.3 | 2033.3 | 809.1 |

^aSD, standard deviation.

^ba positive (+) sign indicates gain in weight, a negative sign (-) indicates loss of weight.

^cp < 0.001 using the Mann-Whitney test on normally distributed data

*p < 0.05, **p < 0.001 comparing Medicine and Surgery patients using the Mann-Whitney test on log-transformed data

TABLE 3.- Sex-adjusted partial correlation coefficients for body mass index and other variables, by source^a

| Source Variable | Medicine | Surgery |
|---|------------|------------|
| Age | 0.1213 | 0.3224*** |
| Current body weight (kg) | 0.9354*** | 0.9024*** |
| Height (cm) | 0.0495 | -0.0551 |
| Triceps Skinfold Thickness (TS,cm) | 0.6989*** | 0.6547*** |
| Mid-upper Arm Muscle Circumference (MUAC,cm) | 0.7294*** | 0.8162*** |
| Mid-upper Arm Muscle Circumference (MUAMC,cm) | 0.1848* | 0.4659*** |
| Wrist Circumference (WC,cm) | 0.7054*** | 0.5865*** |
| Body Size | -0.7176*** | -0.6250*** |
| Albumin | 0.0332 | 0.1249 |
| Hemoglobin | 0.1786* | 0.1058 |
| Total Lymphocytes | -0.0028 | 0.0664 |

^aWhere necessary, variables were log-transformed.

*p < 0.05; **p < 0.01; *** p < 0.001.

Body mass index was also correlated with age in the Surgery group.

Multiple regression analyzes were performed to investigate what variables contributed significantly to a model

in which body mass index was the dependent variable. The results are presented in table 4. Age, triceps skinfold thickness, mid-upper arm circumference, and wrist circumference contributed significantly to the model in both

TABLE 4.— Multiple regression of body mass index (BMI) versus selected variables^a

| | Medicine Coefficient ± SE ^b | Surgery Coefficient ± SE |
|---------------------------------------|---|-----------------------------|
| Intercept | -0.579 ± 0.325 | -1.007 ± 0.275*** |
| Age | 0.097 ± 0.024*** | 0.093 ± 0.019*** |
| Triceps Skinfold Thickness (TS,cm) | 0.143 ± 0.019*** | 0.088 ± 0.020*** |
| Mid-upper Arm Circumference (MUAC,cm) | 0.483 ± 0.102*** | 0.803 ± 0.083*** |
| Wrist Circumference (WC,cm) | 0.526 ± 0.154** | 0.323 ± 0.090*** |
| Sex ^c | N.S. | 0.058 ± 0.023* |
| r ^{2d} | 0.698 | 0.762 |

^aBMI, age, TS, MUAC, and WC were log-transformed; only the most parsimonious models are presented.

^bSE, standard error.

^c1 = male; 2 = female.

^dr^{2d}, explained variance of the model.

*p < 0.05; **p < 0.01; *** p 0.001.

N.S., not significant

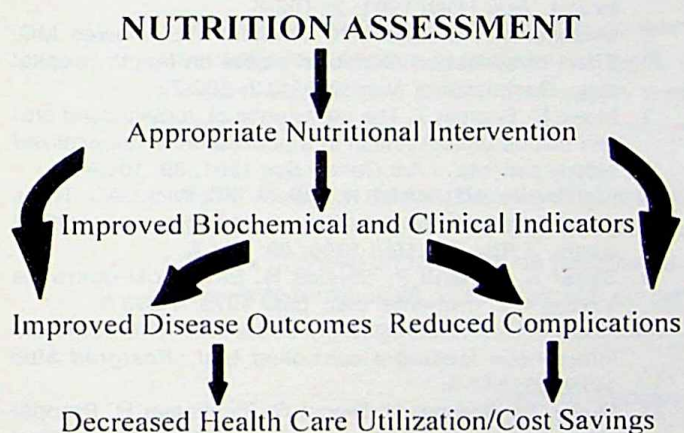


Fig. 1.— Model of the effect of nutrition intervention on outcomes and cost savings. Adapted from Mason M, ed. Costs and Benefits of Nutritional Care, Phase I. Chicago, Ill: American Dietetic Association; 1979.

groups, indicating a relatively greater body mass index for increasing values of each variable when the others were held constant. A significant positive regression was found for sex in Surgery subjects, thereby indicating that for the same age, triceps skinfold thickness, mid-upper arm circumference, and wrist circumference, women had a higher body mass index compared with men. The combination of these variables explained 70 and 76 percent of the variance in body mass index in Medicine and Surgery patients, respectively.

Comparison of methods for the identification of malnourishment

Venn diagrams showing the number of patients detected as malnourished by measuring % WL, BMI, and

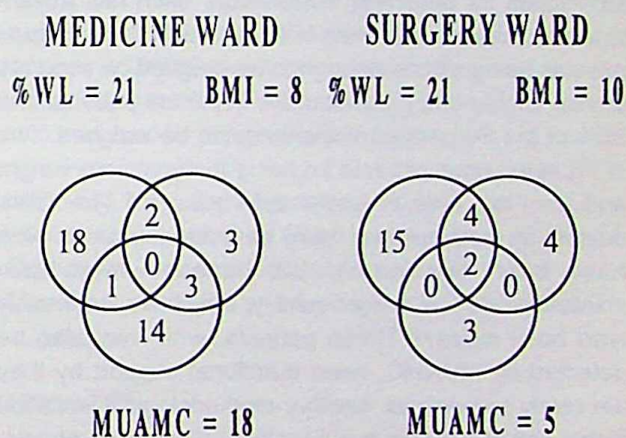


Fig. 2.— Venn diagram showing the number of patients detected as malnourished by the three methods, in 170 Internal Medicine and 176 General Surgery ward patients in whom percentage weight loss (%WL), body mass index (BMI) and mid-upper arm muscle circumference (MUAMC) could be determined.

MUAMC are depicted in fig. 2. For the Medicine group, no patients were detected as malnourished by all three methods. %WL detected the most patients as malnourished (18/170, 11%). Fourteen patients (8%) were declared malnourished by MUAMC alone and 3 (2%) by BMI alone. For the Surgery group, only 2 patients (1%) were identified as malnourished by all three methods, while %WL alone identified 15 (9%), MUAMC alone 5 (3%), and BMI alone 4 (2%).

Discussion

The present study investigated a cohort of recently hospitalized subjects using a multicomponent body composition model to estimate their nutritional status. Re-

sults suggest that, in this population, patients admitted to the Medicine and Surgery wards are, on average, slightly overweight, as expressed by their BMI. No substantial differences in nutritional status were found between these two groups, suggesting that medical variables (i.e., patient's diagnosis) might be poor nutritional predictors.

In interpreting these observations, we must consider several points. Potential confounders, such as tobacco and alcohol use, fat and caloric consumption, daily physical activity, and social class of the patients were not collected as part of the present study. The explained variances of the regression models developed in Medicine and Surgery patients were high (~70 and 76 percent, respectively), however, this does not imply that the models can be used to predict BMI. No advanced model building techniques were used to develop the best prediction models.

Although there is considerable overlap between the techniques for detecting malnutrition, each has advantages and drawbacks. Both %WL and BMI depend upon patients being mobile enough to be weighed on accurate scales. Eighty-one percent of the Medicine patients and 95% of the Surgery participants could be weighed. The %WL relies upon patients 'knowing' their previous weight and then not over or under estimating it.⁸ The %WL detects as malnourished many patients who are or who have been overweight, but because they have unintentionally lost weight quickly, they have lost mainly lean body mass.²⁵ These patients, who may also be detected by MUAMC, need nutritional support by they are rarely recognized. Another methodological limitation is that serum albumin is a negative acute phase protein, and the serum concentration is influenced by fluid shifts²⁶, which we have not assessed in this study.

The method of combining % WL, BMI, and MUAMC, proposed by Nightingale et al.⁸, proved not to be reliable in our population. We strongly support the idea that obtaining data to assess the nutritional status of patients is essential to optimal patient care, especially for patients at high risk of malnutrition.²⁷ However, their method showed, with few exceptions, that each measurement identified different individuals as being malnourished. Furthermore, emphasis should be placed on the fact that it is not enough to assess and identify malnutrition. Outcomes are improved and costs are saved only when appropriate nutritional intervention is made available to those who need it. Dietitians are ideally positioned to assess and recommend appropriate, timely, and cost-effective nutrition.²⁸ As shown in this paper, more attention should be paid to the nutritional status of every hospitalized patient. Therefore, we believe all hospitals should include a nutrition support team. When fulfilled, these objectives will lead to a better outcome for the patients,

and ultimately to a significant cut in the health care costs for the community in general.

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Besides dreams of velocity, or in connection with them, there is in every child the essentially human urge to reshape the earth, to act upon a friable environment (unless he is a born Marxist or a corpse and meekly waits for the environment to fashion him). This explains a child's delight in digging, in making roads and tunnels for his favorite toys.

Además de los sueños de velocidad, o en conexión con ellos, hay en todos los niños la necesidad esencialmente humana de reformar la tierra, actuar sobre un friable ambiente (a menos que sea un marxista de nacimiento o un cadáver y mansamente espere que el ambiente lo forme a él). Esto explica el placer de los niños en cavar, en hacer caminos y túneles para sus juguetes favoritos.

Vladimir Nabokov (1899-1997)

Speak, Memory. New York: G. P. Putnam's Sons, p 302