INTERCÂMBIO INTERNACIONAL:
A RELEVÂNCIA DE UM ESTÁGIO DE INVESTIGAÇÃO CLÍNICA EM NUTRIÇÃO

INTERNATIONAL INTERCAMPUS:
THE RELEVANCE OF A RESEARCH TRAINING IN CLINICAL NUTRITION

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RESUMO

Este trabalho é a compilação dos relatórios e apresentações realizados por dois alunos de Medicina da Universidade Comenius Martin da Eslováquia, no âmbito da sua participação no programa de intercâmbio internacional para fomentar a Investigação Clínica: *Standing Comittee on Research Exchange* (SCORE) *of International Federation of Medical Students' Associations*. Estes alunos realizaram um Estágio de Investigação Clínica na área da Nutrição durante o mês de Julho de 2009, na Unidade de Nutrição e Metabolismo, Instituto de Medicina Molecular da Faculdade de Medicina da Universidade de Lisboa em colaboração com o Serviço de Radioterapia do Hospital Universitário de Santa Maria. Os objectivos centrais foram a aprendizagem, familiarização e aplicação de metodologias específicas de investigação, i.e. pesquisa de literatura em base de dados internacional (*PubMed*), inserção de referências no *software* de gestão bibliográfica *EndNote*®, escrita de relatórios sucintos sobre 2 temas pré-definidos e apresentação oral dos resultados com palestra em suporte *PowerPoint*®. O estágio incluiu também uma introdução às Ciências da Nutrição, área nova e desconhecida para os alunos, que motivou a escolha deste estágio uma vez que não faz parte dos seus currículos do curso de Medicina. Os alunos tiveram ainda contacto com a realidade hospitalar do Serviço de Radioterapia do Hospital de Santa Maria, e prática da avaliação da composição corporal.

Os temas propostos para aplicação das metodologias de investigação acima mencionadas centraram-se na área da Nutrição: na 1ª quinzena do estágio desenvolveram o tema "*Nutrition Intervention Protocols in Oncology*", e na 2ª quinzena "*Body composition evaluation in Oncology with BIA*". Para cada tema os alunos realizaram um relatório estruturado que veiculasse a pertinência do tema e o estado da arte (*Research and Educational Report*) e no final de cada quinzena apresentaram oralmente os resultados da pesquisa bibliográfica. Todas as actividades propostas, bem como a integração dos alunos num projecto de investigação Clínica em Nutrição

actualmente em curso, tiveram como objectivos máximos desenvolver e aprofundar conhecimentos em Nutrição, bem como aprendizagem e aplicação de metodologias internacionalmente validadas e específicas, tanto no contexto da avaliação nutricional, como relativas a actividades de Investigação.

Palavras-chave: investigação clínica; nutrição; revisão bibliográfica; estado nutricional; composição corporal; oncologia.

ABSTRACT

This paper is a compilation of the reports and presentations made by two medical students of the Martin University of Slovakia during their international intercampus training - *Standing Comittee on Research Exchange* (SCORE) *of International Federation of Medical Students' Associations.*

The students carried out a training program on research method in Clinical Nutrition during July 2009 at the Unit of Nutrition and Metabolism, Institute of Molecular Medicine of the Faculty of Medicine and at the Radiotherapy Department of the Santa Maria University Hospital. The main goals consisted on learning, familiarizing and applying scientific research specific methods, i.e. literature research in an international database (*Pubmed*), references insertion in a reference management software *EndNote*®, writing of two small reports about given topics and an oral presentation of the results using *PowerPoint*® format. The training also involved an introduction to Nutritional Science, a new and unknown field for medical students, which was the cause for their choice, once the medical degree does not include such subject. They also had some contact

with the hospital reality at the Radiotherapy Department and practiced body composition evaluation.

The topics set as subject to practice the above said methods focused in the field of nutrition: during the first 15 days they developed the subject "*Nutrition Intervention Protocols in Oncology*" and during the last 15 days worked on the theme "*Body composition evaluation in Oncology with BIA*". For each topic the students should write a structured report that justified the relevance of the theme and the state of the art related to it (*Research and Educational Report*) and at the end of each two weeks they orally presented the results of their bibliographic research.

All activities, as well as the integration in a Clinical Nutrition Research Project, had as main goals to develop and deepen their knowledge in Nutrition, also learning and applying internationally accepted specific methods in the context of nutrition evaluation and research.

Keywords: clinical research; nutrition; bibliographic review; nutritional status; body composition; oncology.

Research and Educational Report 1

Nutrition Intervention Protocols in Oncology

Nutrition in Oncology

Adequate nutrition care is mandatory in oncology, before, during and after treatment(s), in order to prevent overall deterioration and nutritional decline, which are associated with adverse outcomes and worse Quality of Life (QoL) [1, 2]. This can only be achieved with a timely nutritional risk screening and a thorough evaluation of nutritional status integrated in routine

practice. Nutritional intervention should be implemented as soon as cancer is diagnosed and should be considered as an adjuvant measure within the global oncology strategy [3, 4] to increase tolerance and response to treatments; moreover, individualized nutrition is essential to control/modulate cancer-related symptoms and morbidity [2, 4].

Nutritional assessment tools

These methods should meet several criteria: easy to use, cost-effective, and reproducible in several clinical settings, ability to identify patients in risk of malnutrition, patients already undernourished or with excessive body weight/obesity, and in urgent need of nutritional intervention. Nutritional screening can be performed using different tools with different goals. For nutritional risk, one can use *Malnutrition Universal Screening Tool* (MUST), *Nutritional Risk Screening* (NRS) and *Malnutrition Screening Tool* (MST). All are valid tools, although the evaluated parameters are different. MUST includes Body Mass Index, involuntary weight loss in the previous 3-6 months, the acute effect of the disease on diet intake, guidance for nutrition intervention; patients are then categorized in low risk, medium risk or high risk of malnutrition. It can be used in the hospital by all healthcare professionals because no specific knowledge about nutrition is required. NRS is used according to the recommendations of the *European Society for Clinical Nutrition and Metabolism* [5] and is a reliable tool for decisions on nutritional support. Nutritional risk is scored from 0 to 7 [6]; scores 3 indicate malnutrition [5]. MNA was developed for elderly patients and includes clinical data, patient interview, height, current weight, ideal weight and weight change [7]. MST is easy to use and is a good predictor of nutritional status in radiation oncology outpatients [8]; it is based on appetite scores and recent unintentional weight loss, providing a score between 0 - 5, with risk of malnutrition if score ≥ 2 [9].

To assess nutritional status, we can use *Subjective Global Assessment* (SGA), *Patient-Generated Subjective Global Assessment* (PG-SGA) and the MNA in elderly patients. SGA is a

validated method, originally developed in 1980s; it was based on the hypothesis that restoration of food intake can rapidly reduce the risk associated with malnutrition. PG-SGA is an adaptation of SGA to oncology specificities [1]. The first 4 sections of PG-SGA are to be completed by the patient, and the remaining by the clinician; of note that this might not be possible in some scenarios due to cultural and social reasons, and in these cases the whole method is completed by a clinician with differentiation in Nutrition during the patient interview. PG-SGA comprises the scoring of weight loss, disease stage, metabolic stress and physical examination, after which nutritional status is classified as A (well nourished), B (moderate/suspected malnutrition) or C (severely malnourished) [1].

Specific aspects of nutrition intervention in cancer have been addressed by Ottery *et al* at the Fox Chase Cancer Center, USA. The algorithm for optimal nutritional intervention was based on clinical practice and clinical research. Although at a first glance the algorithm may seam complex, only 2 components are needed to define the general approach to each patient: PG-SGA staging (A, B, C) and the category of nutritional risk attributed to the cancer therapy. High-risk cancer therapy determines 30-50% of severe nutritional impact symptoms (e.g., nausea, vomiting, diarrhea, stomatitis/mucositis, sensory changes). In terms of radiotherapy, the irradiation location, area, dose, fractions, and its combination in a multimodal regimen, all affect the risk of nutritional deterioration. Based on the patient's baseline deficit and the nutritional risk of the cancer therapy, intervention may range from the use of patient educational materials to proactive or prophylactic enteral tube feedings or parental nutrition [1].

State of the Art

1. Protocol of the Spanish Nutrition and Cancer Group – Created by Groups of Health Professionals associated with the *Sociedad Española de Nutrición Básica y Aplicada* (SENBA) to

address strategies to improve the quality of nutritional intervention in cancer. This group developed a protocol describing nutritional assessment and intervention in form of algorithms based on literature and personal experience. The patients are classified in a 3 step process: 1. antineoplastic treatment (curative or palliative); 2. nutritional risk of the treatment (low, medium, high) and 3. PG-SGA score. Patients are then classified as: A (adequate nutritional status), B (malnutrition or risk of malnutrition) or C (severe malnutrition).

2. ESPEN Guidelines - This project was carried out as a continuous quality improvement project. Four different specialities participated in the study with a nutrition team of doctors, nurses and a dietitian, and included the following methods: 1. Pre-measurement: assessment of quality goals prior to study including the use of nutritional risk screening (NRS-2002), and whether a nutrition plan was made with documented monitoring. 2. Intervention: multidisciplinary meeting for the ward staff using a PC-based system for detecting barriers concerning nutrition in the departments, elaboration of an action plan and implementation of the plan. 3. Re-assessment: based on information from records and patient interviews, and an evaluation based on group interview with the staff [10].

3. Patients with colorectal carcinoma and malnutrition - In the *Hospital General Universitario de Guadalajara* - Spain, a study was conducted to evaluate nutritional status of colorectal cancer patients' undergoing chemotherapy, with the PG-SGA. Patients were classified in 1 of 4 levels of intervention: 1. No intervention required; 2. nutrition education; 3. nutritional intervention; 4. critical intervention according to patients' nutritional status (well nourished, moderate or severe malnutrition).

4. SGA *vs* PG-SGA - Bauer *et al* from the *Wesley Research Institute in Brisbane* evaluated the use of scored PG-SGA as a nutrition assessment tool in hospitalized cancer patients, and compared its performance with the SGA in terms of sensitivity, and specificity, and determined

patients' nutritional outcomes. Seventy-one patients aged 18-92 yrs were included. They concluded that: scored PG-SGA was superior to SGA; PG-SGA was as an easy to use nutrition assessment tool that allows a quick identification and prioritization of malnutrition in hospitalized cancer patients [11].

5. Nutritional Screening Tools used in a Portuguese Oncology Centre - Screening values of MST and MUST were calculated using the NRS 2002 as reference method. Their ability to predict longer length-of-hospital stay (LOS), defined as ≥7 days, was assessed. The authors concluded that MUST had the highest agreement with NRS-2002 in hospitalized cancer patients, and better identified patients at-risk for a longer LOS [12].

Discussion

Oncology patients benefit from multiprofessional patient management [13], which include assessment of nutritional risk and status, optimize nutritional treatment for patients´ individual requirements. Early diagnosis and intensive nutritional intervention proves efficient for most of the patients.

Nutrition Intervention Protocols in Oncology

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- Relevance of nutrition in oncology
- Nutritional assessment tools
  - MUST, NRS, MNA, MST, SGA, PG-SGA
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Why is nutrition important in oncology?

Cancer and its treatment cause symptoms which increase patients´ **risk of malnutrition**

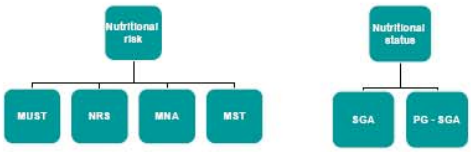
Nutritional intervention has an additional and specific role:

- increased tolerance and response to treatment
- better control of cancer-related symptoms
- decreased rate of complications
- shortened length of hospital stay
- improved patients´ outcome
- reduced morbidity and possibly reduced mortality

Screening for malnutrition

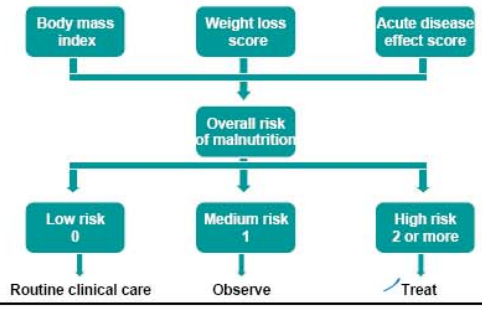
Criteria for nutritional assessment tools:

- easy to use
- cost-effective
- reproducible in several clinical settings
- ability to correctly identify patients in risk of malnutrition, patients in urgent need of nutritional intervention…



NUTRITIONAL RISK

MUST - *Malnutrition Universal Screening Tool*



NUTRITIONAL RISK

NRS - *Nutritional risk screening*
- according to recommendations of ESPEN (*European Society for Clinical Nutrition and Metabolism*)
- reliable tool for decisions on nutritional support
- nutritional risk is scored from 0 to 7; score ≥ 3 = malnutrition

MNA - *Mini nutritional assessment*
- developed for elderly patients
- includes clinical data, patient interview, height, current weight, ideal weight and weight change

MST - *Malnutrition screening tool*
- good predictor of nutritional status in radiation oncology outpatients
- based on appetite scores and recent unintentional weight loss,
- nutritional risk is scored from 0 to 5; score ≥2 = malnutrition

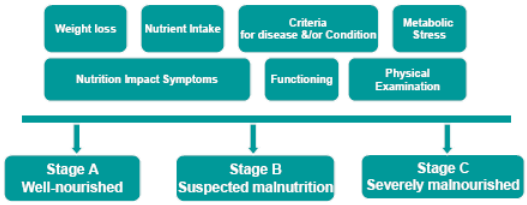
NUTRITIONAL STATUS

SGA - Subjective Global Assessment

- Validated tool to assess nutritional status

PG SGA – Patient Generated Subjective Global Assessment

- Adaptation of SGA to oncology specificities



State of the art

1. Protocol of the Spanish Nutrition and Cancer Group

Strategies to **improve the quality of nutritional intervention** in cancer

Developed a **Protocol** describing nutritional assessment and intervention in form of algorithms

Patients are classified in a 3 step process:

1. antineoplastic treatment (curative or palliative)
2. nutritional risk of the treatment (low, medium, high)
3. PG-SGA score

2. Nutritional Screening Tools used in a Portuguese Oncology Centre

Screening values of MST and MUST were calculated using the **NRS 2002 as reference method**

Ability to predict longer length-of-hospital stay, defined as ≥7 days, was assessed

MUST had the highest agreement with NRS-2002 in hospitalized cancer patients, and better identified patients at-risk for a longer length of stay

Amaral F, et al. J Hum Nutr Diet. 2008; 21: 575-583.

Conclusion

- **Multiprofessional patient management protocol should be implemented to start immediately after cancer is diagnosed.**
- **Early diagnosis and intensive nutritional intervention proves efficient for most patients.**

Thank you for your attention

Research and Educational Report 2

Body composition evaluation in Oncology with BIA

Bioelectric Impedance Analysis (BIA) is an objective, easy-to-use, safe, quick, non-invasive and reproducible technique that evaluates body composition. This method is based on the principle that an electrical current flows at different rates through body tissues, depending on their composition. It measures the percentage of body fat, percentage of fat free mass, total body water and the water in extra and intra-cellular compartments [14]. The human body is composed mostly of water with ions, through which an electrical current can flow; water is localized in two compartments: extra-cellular water (ECW, approximately 45%) and intracellular water (ICW, approximately 55%) [15]. On the other hand, the body also contains non-conducting materials (body fat) that generate resistance to the flow of the electric current. Adipose tissue is significantly less conductive than fat free tissues (muscle or bone) [16]. The principal of BIA is that electric current passes through the body at a differential rate depending on body composition impedance [17].

In clinical practice, BIA can be performed with a tetrapolar electrode method; electrodes are placed in the right wrist and ion the right ankle. The subject should be lightly clothed but without shoes or socks, and lie supine with the extremities away from the body and not touching each other [18].

The foundations of BIA were established in the 1970s [19] and its use to assess nutritional status in cancer patients is increasing [14]. Modifications of body composition are frequent in these patients [20]. Advanced cancer patients frequently have fluid retention (ascites, pleural effusion, and peripheral oedema), which may affect BIA results [18], since impedance is inversely related to tissue fluid content and might be affected by fluid content.

State of the art

1.The relationship between BIA phase angle and Subjective Global Assessment (SGA) in advanced colorectal cancer – the objective of this study was to investigate the association between BIA derived phase angle (a relationship between reactance Xc and resistance R) and SGA. Patients with advanced colorectal cancer were classified as well-nourished or malnourished using the SGA. BIA was conducted on all patients and phase angle was calculated. Well-nourished patients had a statistically higher phase angle as compared to those who were malnourished. The study suggests that BIA phase angle is a potential nutritional indicator in advanced colorectal cancer [14].

2. Bioimpedance vector pattern in cancer patients without disease *vs* locally advanced or disseminated disease – whole-body impedance measurements were made in 148 adult, white male subjects (45-85 years old): 56 healthy subjects, 31 cancer patients with controlled disease, and 61 patients with locally advanced or disseminated disease with the same body mass index and age. All patients were free from antineoplastic treatment and received active nutritional intervention. Monitoring vector displacement trajectory towards the reference target vector position may represent a useful feedback in support therapy planning of individual patients [21].

3. Altered tissue electric properties in lung cancer patients as detected by BIA vector analysis – the distribution of the impedance vectors was evaluated in 63 adult male patients with lung cancer in supportive therapy. Patients were compared with 56 healthy subjects matched for gender, age, and body mass index. Impedance vectors in lung cancer patients were characterized by a reduced reactance component. The altered tissue electric properties were more predictive prognosis *vs* weight loss [20].

Discussion

The assessment of fat-free mass and body fat mass provides valuable information about changes in body composition. It can also be used as a prognostic tool in dialysis and cancer patients. Phase angle determined by BIA, detects changes in tissue electrical properties and has been found to be a prognostic tool in cancer patients.

Body composition evaluation in oncology patients by BIA

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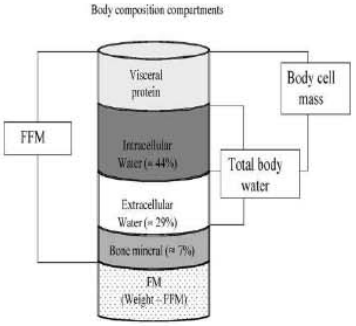
Body composition and oncology



✓ modifications of body composition are frequent in cancer patients

✓ BIA can specifically detect changes in tissue electric properties, which may be associated with outcome

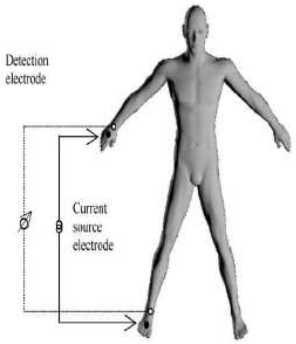
Bioeletrical impedance analysis

- objective
- easy-to-use
- safe
- non-invasive
- **reproducible technique to measure percentage of** :

body fat
fat free mass
total body water
water in extracellular and intracellular

- During BIA alternating electrical current flows through the body composed mostly of water with ions
- The body also contains non-conducting materials (body fat) that provide resistance to the flow of electric current
- Impedance is inversely related to tissue fluid content

BIA results can be influenced by fluid content
fluid retention
environment
ethnicity
phase of menstrual cycle
medical conditions



✓ BIA is measured between the right wrist and right ankle using a tetrapolar electrode method

✓ The subject can be lightly clothed but without shoes or socks

State of the art

"The relationship between bioelectrical impedance phase angle and subjective global assessment in advanced colorectal cancer"

- **Objective**: to investigate association between BIA derived phase angle and SGA in advanced colorectal cancer
- Patients were classified as either well-nourished or malnourished using the SGA
- **Conclusion**: suggestion that bioelectrical impedance phase angle is a potential nutritional indicator in advanced colorectal cancer

Gupta D, et al. Nutr J 2008; 7: 19.

"Altered tissue electric properties in lung cancer patients as detected by bioelectric impedance vector analysis"

- **Objective:** to evaluate the distribution of the impedance vectors from 63 adult male patients with lung cancer in supportive therapy
- Patients were compared with 56 healthy subjects matched for gender, age, and body mass index
- **Conclusions**: impedance vectors from lung cancer patients were characterized by a reduced reactance component; altered tissue electric properties were more predictive of prognosis *vs* weight loss

Toso S, et al. Nutrition 2002; 18: 1004.

Conclusion

- Assessment of fat-free mass and body fat provides valuable information about changes in body composition
- Phase angle, determined by bioelectrical impedance analysis, detects changes in tissue electrical properties and has been found to be a **prognostic tool in cancer patients**

Thank you for your attention

CONCLUSÕES

A área da Investigação Clínica é trabalhosa mas extremamente enriquecedora. Exige a aquisição de conhecimentos variados sobre metodologias específicas de investigação e a recolha de informação útil, verdadeira e reprodutível. Este estágio de Investigação em Nutrição Clínica envolveu um trabalho de pesquisa intenso, bem como o estudo de conceitos de Nutrição básica e prática no âmbito dos temas pré-definidos.

A realidade hospitalar, assim como a respectiva cultura, são características únicas de cada país. O contacto com esta diversidade é bastante enriquecedor, quer para quem visita novas realidades quer para os anfitriões, aguçando a curiosidade de todos. A par de uma experiência hospitalar diferente, estes alunos contactaram também com uma nova área – Nutrição Clínica. Uma vez que esta área das Ciências não existe no Curriculum de Medicina, o médico não recebe formação em Nutrição durante o curso. No entanto, o doente presume que o médico é especialista em todos os problemas relacionados com a saúde, incluindo a nutrição, e por isso é a ele que expõe as suas dúvidas que muitas vezes acaba por não ver esclarecidas.

A terapêutica e o acompanhamento multidisciplinar do doente oncológico são cruciais e verifica-se cada vez mais serem indispensáveis à adesão e tolerância do doente ao tratamento e melhoria do prognóstico. A avaliação e intervenção nutricionais individualizadas desempenham um papel fundamental para a manutenção de um bom estado geral e melhor Qualidade de Vida desde que iniciadas no momento certo no contexto da modulação sintomática.

Esta oportunidade permitiu, em linhas gerais, mostrar o que é e como está a decorrer um projecto de integração da Nutrição num Serviço hospitalar, neste caso, de Radioterapia, permitindo apreender como se pode planear esta integração para aumentar a respectiva probabilidade de sucesso e quais os benefícios decorrentes para a melhoria da qualidade de vida e

eficácia do tratamento dos doentes. Também permitiu desenvolver conceitos sobre métodos de avaliação corporal e relevância desta avaliação na oncologia.

Como em todos os intercâmbios internacionais, este permitiu aos alunos desenvolverem/melhorarem os seus conhecimentos da língua inglesa e respectivas capacidades de escrita e de expressão oral, uma vez que se viram obrigados a apresentar trabalhos escritos e orais e a exprimirem-se no dia-a-dia em Inglês.

Esperamos ter contribuído para alertar futuros médicos sobre a necessidade da Integração da Nutrição no tratamento multidisciplinar do doente oncológico, bem como de doentes com outras patologias, para a manutenção de um bom estado geral do doente.

Toda a equipa teve muito gosto em recebê-los e em puder contribuir para o enriquecimento das suas vidas profissionais e pessoais enquanto futuros médicos!

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BIBLIOGRAFIA

1. OTTERY F: Definition of standardised nutritional assessment and interventional pathways in oncology. Nutrition 1996;12:15-19.
2. CARO M, LAVIANO A, PICHARD C: Nutritional intervention and quality of life in adult oncology patients. Clinical Nutrition 2007;26:289-301.

3. CARO MM, LAVIANO A, PICHARD C, CANDELA CG: Relationship between nutritional intervention and quality of life in cancer patients. Nutr Hosp 2007;22(3):337-50.

4. CARO M, LAVIANO A, PICHARD C: Impact of nutrition on quality of life during cancer. Curr Opin Clin Nut Metab Care 2007;10:480-7.

5. GUR A: The efficacy of Nutrition Risk Screening-2002 (NRS-2002) to decide on the nutritional support in general surgery patients. Bratisl Lek Listy 2009;110:290-2.

6. BOZZETTI F: Screening the nutritional status in oncology: a preliminary report on 1,000 outpatients. Support Care Cancer 2009;17:279-84.

7. DUGUET A, BACHMANN P, LALLEMAND Y, BLANC-VINCENT MP: Good clinical practice in nutritional management in cancer patients: malnutrition and nutritional assessment. Bulletin du Cancer 1999;86(12):997-1016.

8. FERGUSON ML, BAUER J, GALLAGHER B, CAPRA S, CHRISTIE DR, MASON BR: Validation of a malnutrition screening tool for patients receiving radiotherapy. Australas Radiol 1999;43(3):325-7.

9. ISENRING E, CROSS G, DANIELS L, KELLETT E, KOCZWARA B: Validity of the malnutrition screening tool as an effective predictor of nutritional risk in oncology outpatients receiving chemotherapy. Support Care Cancer 2006;14:1152-56.

10. RASMUSSEN HH, KONDRUP J, STAUN M, *et al*.: A method for implementation of nutritional therapy in hospitals. Clin Nutr 2006;25(3):515-23.

11. BAUER J, CAPRA S: Use of the scored Patient-Generated Subjective Global Assessment (PG-SGA) as a nutrition assessment tool in patients with cancer. European Journal of Clinical Nutrition 2002; 56:779-785.

12. AMARAL TF, ANTUNES A, CABRAL S, ALVES P, KENT-SMITH L: An evaluation of three nutritional screening tools in a Portuguese oncology centre. J Hum Nutr Diet 2008;21:575-583.

13. RAVASCO P: Intensive nutritional counselling. 2005:Rome, Italy.

14. GUPTA D, LIS CG, DAHLK SL, *et al.*: The relationship between bioelectrical impedance phase angle and subjective global assessment in advanced colorectal cancer. Nutr J 2008;7:19.

15. COPPINI LZ, WAITZBERG DL, CAMPOS AC: Limitations and validation of bioelectrical impedance analysis in morbidly obese patients. Curr Opin Clin Nutr Metab Care 2005:8(3):329-32.

16. SCHARFETTER H, SCHLAGER T, STOLLBERGER R, FELSBERGER R, HUTTEN H, HINGHOFER-SZALKAY H: Assessing abdominal fatness with local bioimpedance analysis: basics and experimental findings. Int J Obes Relat Metab Disord 2001;25:502-11.

17. DEHGHAN, M, MERCHANT AT: Is bioelectrical impedance accurate for use in large epidemiological studies? Nutr J 2008;7:26.

18. SARHILL N, WALSH D, NELSON K, HOMSI J, KOMURCU S: Bioelectrical impedance, cancer nutritional assessment, and ascites. Support Care Cancer 2000;8(4):341-3.

19. KYLE UG, BOSAEUS I, DE LORENZO AD, *et al.*: Bioelectrical impedance analysis--part I: review of principles and methods. Clin Nutr 2004;23(5):1226-43.

20. TOSO S, PICCOLI A, GUSELLA M *et al.*: Altered tissue electric properties in lung cancer patients as detected by bioelectric impedance vector analysis. Nutrition 2000;16(2):120-4.

21. TOSO S, PICCOLI A, GUSELLA M, *et al.*: Bioimpedance vector pattern in cancer patients without disease versus locally advanced or disseminated disease. Nutrition 2003;19(6):510-4.