Cancer Patients' Morbidity (III): Malnutrition in Relation to Doctors', Nurses' and Patients' Personality

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Abstract

Background Tailor-made strategies for assessing and improving cancer morbidity, malnutrition, a complex multifactorial syndrome, need to identify patients' characteristics or individuality.

Method Postoperative cancer patients (n=103), gastric, colorectal or breast, TNM stage I-III, and doctors/nurses (n=102) completed the EPQ-25, which measures individual characteristics on personality scores of extraversion (E), neuroticism (N), psychoticism (P) and conformity (L). Malnutrition parameters were obtained by the QOL-20 items and blood sample analysis. Explanation about disease severity from doctors, patient-family relationship, surgical procedure (total or partial gastrectomy), nutritional support (normal oral intake, hyperalimentation, fluid therapy) and radiation therapy of patients were recorded.

Results Patients' personality of less E, P and L and greater N predicted ($P<0.05$-0.001) higher anorexia, asthenia, pain, stress (impeding factors of food intake) or sodium, and lower quality of life (QOL), total protein, triglyceride, total-cholesterol, potassium or lymphocyte level [suggesting a risk of malnutrition], after controlling for tumor site, stage, age, sex, blood type and birth season.

Doctors'/nurses' personality interacting with patients' personality, not either personality alone, significantly predicted QOL, nutritional, anemic and immune status, prognosis of patients after surgery, with doctors' explanation about disease, family relationship, total gastrectomy and oral nutrient intake as differential factors.

Intercorrelations (convergent validity) as a function of personality suggested: malnourished patients have a poor QOL, protein-energy undernutrition, muscle tissue depletion and bodily fluid imbalabces; their stress-related immune function, and anemia responsible for reduced energy metabolism, are influenced by personality.

Conclusion Cancer patients' personality score was an easy, rapid, non-invasive and cost-effective diagnostic tool for identifying which patient is at risk of developing malnutrition. Doctors'/nurses' personality, congenial to patients' personality, may alleviate this risk, with explanation about disease, family relationship, partial gastrectomy and oral nutrition.

Introduction

All cancer patients develop some degree of clinical malnutrition. State of this morbidity, a complex multifactorial syndrome, may differ variously from patient to patient, and is influenced positively or negatively by many different parameters[1-10]. In this circumstance, tailor-made strategies for assessing and improving this morbidity need to identify patient characteristics, in relation to the parameters associated with clinical characteristics of malnutrition. Screening of these malnutrition parameters are expected to take into consideration the influence of individual patients' personality, which will supply refined and broadened patient information having a strong biological underpinning of biochemical individuality[11-16]. Mapping genes for human personality is in progress[17,18], and genetic variance in personality could be contributed by specific genes[19-21]. The occurrence and degree of malnutrition are affected by factors arising from the tumor itself, host response to the tumor, type of tumor, stage of the disease and antineoplastic therapy[22,23] as well as patients' behavior or oral intake of macro-nutrients (Figure 1). Patients' behavior is directly related to nutrition and is influenced by their personality. Behaviorally regulated malnutrition may include protein-energy undernutrition, anemia-related symptoms and complications, impaired immune function, etc.

These clinical symptoms of malnutrition are resulted

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Malnutrition occurs as a consequence of an imbalance among:
① Demands of the tumor.
② Needs of the host.
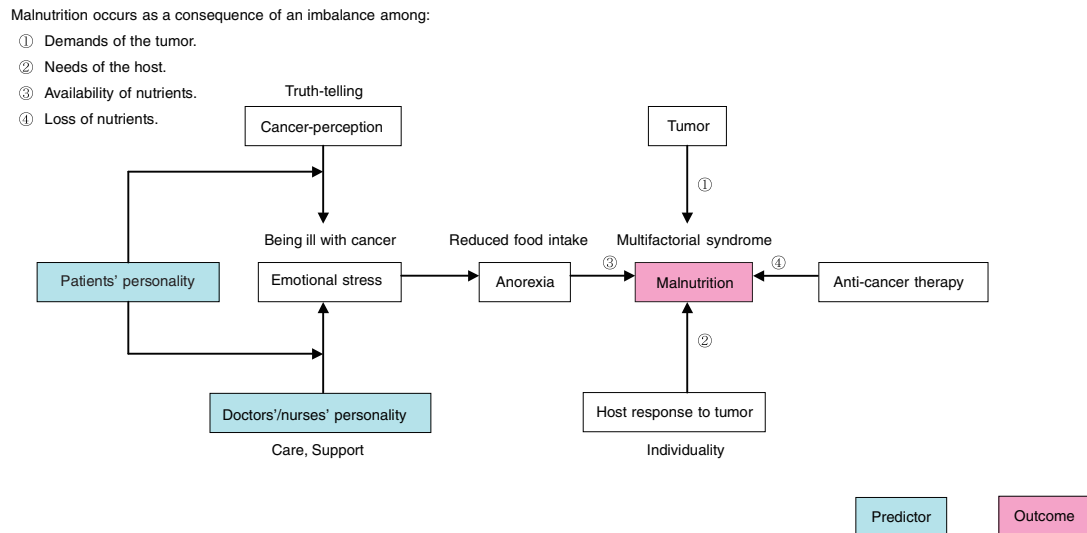③ Availability of nutrients.
④ Loss of nutrients.

Fig. 1 Causal pathway connecting personality, cancer and malnutrition

primarily from the parasitic metabolism of the tumor at the expense of the host, and from impact of the tumor cells on the metabolism of the host, and further from divergent aggressive cancer therapies. Thus, malnourished cancer patients undergoing surgery, mainly for gastrointestinal and related sites or morbidity, are at a higher risk of poor outcomes, complications and mortality. Since malnutrition predisposes the patient to an increased risk of postoperative complications, poor prognosis, shorter survival, etc.; it is essential to predict which patient is at risk of developing anorexia (eating behavior deficit), pain and stress (impeding factors of food intake), so as to prevent and alleviate this risk by appropriate psychological intervention, nutritional support, etc., to ensure sufficient (balanced) protein calorie intake before and after surgery, chemotherapy or radiation therapy.

A number of studies have shown that nutritional support, immune-enhancing nutrition, pharmacological nutrition, etc., have beneficial metabolic effects, reduces the risk of therapy-related complications, reduces length of hospital stay and reduces mortality in many, but not all, patients[1,6,22,23]. Characteristics of patients who are predisposed to cancer-related morbidity, such as deteriorated quality of life (QOL), anemia, anemia-related QOL deficit and immune dysfunction, have been identified with appropriate sensitivity and specificity by psychometrically valid personality trait scores[30-39]. It is very likely then that these personality traits, associated with biochemical individuality[11,12,15,16], predict patients at risk of developing cancer-induced, therapy-related malnutrition, and at the same time, these personality traits predict effectiveness of prophylactic nutritional therapy in reducing the severity of this morbidity and related complications.

In fact, patients' personality, as determined by the 4 major trait scores on the Eysenck Personality Questionnaire (EPQ)[40], was a clinically valid and reliable measure of identifying which patient is at risk of developing impaired immune function, and which patient is under protection against such impairment, when the cancer patient received prophylactic psychological intervention, care or support from the doctor[38]. Similarly, the cancer patients' personality was a sensitive and specific measure of predicting the patient being at risk of developing anemia or anemia-related QOL deficit, and the patient being under protection against such a morbidity[39]. These studies together with other studies indicated that patients' personality score on the EPQ is an easy, rapid, non-invasive and cost-effective diagnostic tool for identifying patients' proneness to major cancer morbidity[30-45].

Function of personality includes modulation of psycho-neuro-immune processes as well as behavior (food intake), perception and feeling (stress, pain, etc.) of a person (patient), interacting with other persons (doctors, nurses, families, etc.) (Figure 1)[24-29,46-48]. It is suggested then that perception of cancer (stress of being ill with cancer, truth-telling about cancer) may induce anorexia, asthenia, pain or immunosuppression and is characterized by personality traits of introversion (E-), neuroticism (N+), vulnerability (P-) and lack of conformity (L-) to others such as doctors, nurses or families. Patients with these personality traits, in other words, intolerant (E-, N+, P-), melancholic (E-, N+) and high-anxious (N+, L-) types would be stress-prone and characterized by poor QOL, less fighting spirit, greater hopelessness or helplessness and poor medical satisfaction. While patients with tolerant (E+, N-, P+), sanguine (E+, N-) or repressor (N-, L+) type may be stress-resistant or resilient and characterized by better QOL, greater fighting spirit and greater medical satisfaction away from malnutrition[24,30-39,108]. This hypothesis (suggestion) is tested in the present study.

It is possible that patients' and medical support pro-

viders' (doctors'/nurses') personalities, congenial to each other or otherwise, influence their behavior, perception and feeling, and patients' anorexia, asthenia, pain, stress and QOL, which in turn modulate (patients') metabolic or immunologic processes. Thus, it is very likely that patients' and doctors'/nurses' personality-related (patients') loss of appetite and bodily strength, suffering from pain, stress of being ill with cancer (due to doctors' explanation about disease severity and poor prognosis; truth-telling about diagnosis, pathology, treatment, prognosis or survival) and impaired QOL are all impeding factors of food intake and subsequent biochemical and immunologic function.

Malnutrition-related anorexia (from the Greek "without appetite") is by definition subjective. It is present in up to 1/2 of newly diagnosed cancer patients[28,49]. Anorexia may result from lack of strength (asthenia), suffering from pain, anxiety, depression, inertia, stress or impaired QOL, as well as systemic responses still unexplained in the tumor process[10,28,29]. It may be an emotional response to the fear or anger experienced by the patients when confronted with adversity, such as truth-telling about cancer or not telling the truth (deceiving), or the result of doctors'/nurses' attitude who are supposed to (so expected by the patients) be alleviating these adversities. Antineoplastic therapies, chemotherapy or radiation therapy as well as surgery, and doctors'/nurses' behavior also produce anorexia, feeding depression and learned food aversions[28]. Such a learning could be influenced by personality of doctors/nurses as well as patients themselves[12,24,27,48]. Therefore, all these factors and symptoms are potential risk of developing anorexia, directly leading to malnutrition; and this risk could be alleviated by the patients' and doctors'/nurses' personality (modulator of anorexia)-based strategy for nutritional care and support, prophylactic nutritional therapy of cancer, etc.

Diagnosis of malnutrition is based on patients' subjectively complaining or reporting of lack of appetite or early satiation (Table 1). Although enormous inter-individual variations exist in oral nutrient intake, cancer patients' anorexia scores and quantified nutrient intakes are in quite high correlation[28,50]. Nevertheless, subjective anorexia and measured inadequate oral intake were only partially concordant, since individual patients may deny variously changes in appetite (as a function of personality) but may nonetheless have a reduced caloric intake[51]. This denial is expected to vary with patients' personality (the EPQ conformity, L, score) in relation to (congenial or not congenial to) support providers', doctors'/nurses', personality[24,27,48]. Therefore, exact quantification of the daily inadequate oral nutrient intake is necessary for verification of the subjective reports and for planning nutritional support strategies. The management of cancer malnutrition depends on the control of all these poten-

Table 1 Assessment in cancer-associated malnutrition

Category	Parameters
Subjective	Scored patient generated subjective global assessment, Linear analogue self-assessment, [Quality of life assessment]
Biomedical	Anemia, Fatigue, Wasting, Edema, Fluid retention, Venous pressure, Muscle atrophy, Diarrhea, Decubiti, Sepsis, Ascites
Psychological	[Anorexia], Reduced food intake, Learned food aversion, [Pain], [Emotional stress], Apathy, Depression, Lack of concentration, Inertia
Sociodemographic	Dietary history, Eating habit, Food preference
Physical	[Asthenia], Bodily strength, Performance status, Hand grip strength, Exercise tolerance, Muscle function, Impedance-metry
Anthropometric	Weight loss (influenced by edema, acites, hydration, etc.), Body mass index (not useful in low weight patients), Muscle circumference, Skinfold thickness
Biochemical	[Protein] ([total], retinol binding, albumin, prealbumin), [Triglyceride], [Cholesterol] ([total]), [Glucose], [Sodium], [Potassium], Calcium, Creatinin, Urea, [Erythrocyte], [Hemoglobin]
Immunological	Leucocyte, Neutrophil, [Lymphocyte] ([count], proliferation)

[ ]=Parameters associated with personality in the present study (cf. Tables 4-6).

tially reversible factors (anorexia, stress, pain, QOL, etc.) as a function of patients' personality, in relation to doctors'/nurses' personality, which are the non-reversible (stable) risk or protective factors[17,24,31].

Thus, cancer morbidity associated with nutritional/metabolic status varies with many different parameters, psychosocial and biochemical, among individual patients, which must be controlled or taken into consideration by stratification, in order to lead tailor-made nutritional support or intervention for each patient as an integral part of cancer therapy. In such a support or care of patients, it is of great importance to identify as early as possible patients at potential risk of becoming malnourished, so as to design prophylactic strategies adjusted to each patient need. These strategies will prevent therapy related complications, reduce disease severity and prolong survival, hence reduce length of hospital stay and medical cost. Results of previous studies of cancer patients' morbidity concerned with immunologic status and anemia-related QOL[38,39] have pointed to specific personality traits and types (stable individual difference factors throughout life, influence of which exceeds explainable biogenetic or physiological factors on the cancer morbid conditions)[11-21] as reliable and clinically useful premorbid factors for detecting (at earliest point in time) patients at risk of developing these morbid conditions.

The present study continues to identify and stratify as rapid and cost-effective as possible individual patients characteristics, in terms of psychometric personality trait scores, at risk for or protection against major cancer mor-

bidity, concerned with multifactorial malnutrition and related morbidity, subjective, psychological, biochemical, metabolic, anemic and immunologic. These personality scores on the EPQ have been shown to influence interpersonal processes[24,27,48], as in cancer patients interacting with their doctors/nurses or families (Figure 1). In this circumstance, the present study examines whether doctors/nurses personalities are congenial to or otherwise and interact with patients' personality in alleviating cancer morbidity, malnutrition, and improve patients' QOL, using the same personality instrument (the EPQ), as used in the previous studies[30-39].

Interdisciplinary tailor-made strategy for alleviating cancer malnutrition of each patient, by appropriate nutritional support and care, which affects his/her response to anti-neoplastic therapy, is expected to focus on the contribution of personality as a regulator of feeding behavior and dietary function. When they are made congenial to patients' personality by appropriate assessment, the doctors'/nurses' personality will constitute a major part of the prophylactic strategy for alleviating patients' risk of malnutrition, improving their response to therapy, QOL and immune function, reducing the incidence of pain, treatment-related side effects, etc.

Nutritional screening and assessment in cancer-associated malnutrition, progressive deterioration in nutritional status of patients, have included: patients' subjective report, biomedical diagnosis, and psychological, sociodemographic, physical, anthropometric, biochemical and immunological assessment (Table 1)[1-10,22,23,26,28,29,49-86].

In many studies, loss of appetite (anorexia, reduced food intake), loss of physical strength (asthenia, muscle wasting, debility) and impaired immune function (reduced lymphocyte level) were most predictive of nutrition-associated morbidity (chronic undernutrition) in cancer patients. Anorexia was almost universal among patients with advanced disease (Table 1). Loss of body weight or body mass index (BMI) had limited accuracy, providing an approximate guide in predicting nutritional status of cancer patients, due to fluid retention or edema and related factors. On the contrary, those predictors as loss of appetite and bodily strength were well associated (with appropriate sensitivity and specificity) with malnutrition, nutrition-associated morbidity[85], chemotherapy and radiation therapy side effects or related complications in cancer patients. Simple questionnaires with appropriate psychometric properties (validity, reliability, easy to respond by elderly or severely ill patients, etc.) for these behavioral symptoms (impeding food intake, nutrient supply and bodily activity) contain additional information on nutritional support and care, so as to offer better treatment of patients improving their QOL and prolonging disease-free survival.

A large body of evidence exists which demonstrates the importance of nutritional support and care (behav-ioral intervention, which must be adjusted to each patient's need) attenuating cancer-associated wasting and improving immune function[6,22,28]. However, results of clinical studies using these screening devices and assessment indexes have not always been consistent among many different patients. In fact, patient characteristics responsible for these differences are not well understood. Further research is needed focusing on these characteristics or biochemical individuality[11,12,16]. Taking advantage of controlling or removing by stratification the effects of irrelevant factors involved in patients' response to cancer, a strategy which exploits personality assessment has been shown to be instrumental in providing, cancer patients' clinical outcomes, consistent results including global QOL, anemia-related QOL deficit, natural killer (NK) cells, lymphocytes, lymphocyte proliferation, cholesterol, cortisol and hemoglobin levels[30-39,42].

If patients' and doctors'/nurses' individual difference factors (including personality, antecedent of which is DNA, genetic personality determinant)[12,17-21] are neglected, cancer clinical trials such as nutritional therapy or support may contribute relatively little to the treatment of malnutrition, leading to no generally tenable conclusions. It would not be sensible to give a scoreboard total (regardless of each patient's characteristic) or to suggest that results of these clinical trials are necessarily universally true and can be applied equally to every cancer patient. Studies of patients' personality with various types of cancer suggest optimal conditions for individual patients' needs for nutritional as well as psychological support or intervention[31-45]. Reasons for the discrepancies among these conditions for individual cancer patients may be related to their differential response to support providers' (doctors'/nurses', families') personalities as well as their own personality characteristics.

Nutritional support or intervention for the prevention and treatment of cancer-associated malnutrition is an essential part of the cancer therapy and should be initiated earlier. Since there are no specific globally accepted nutritional guidelines available for patients with cancer; prolonged nutritional support or intervention should be tailored to individual patients, so as to meet their requirements. Such a support or intervention is expected to improve immune function, enhance cancer therapy effectiveness, reduce tumor growth and complications and improve QOL and overall survival.

The present study, third in a series of five[38,39,103,104], is designed to continue personality-based strategy for cancer research and therapy, focused on individual patient characteristics, predicting danger for malnutrition. A task here is therefore to identify potential patients who are at nutritional risk (as quickly, easily, non-invasively and cost-effectively as possible) so as to provide evidence for the tailor-made strategy for preventing high risk cancer malnutrition. Since no single measurement of parameters

Table 2 Summary statistics of the cancer patients and doctors/nurses

	Patients				Doctors/nurses*
	Gastric (n=53)	Colorectal (n=27)	Breast (n=23)	All (n=103)	(n=102)
Age, mean (SD)	60.6 (12.2)	62.6 (9.1)	55.3 (9.0)	59.5 (10.1)	35.7 (10.4)
Range	29-80	41-80	40-74	29-80	21-57
Sex %					
Male	58.3	71.4	0.0	43.2	34.7
Female	41.7	28.6	100.0	56.8	65.3
TNM stage %					
I	63.3	28.7	31.6	41.2	
II	21.5	35.0	29.9	28.8	
III	15.2	36.3	38.5	30.0	
Days after surgery					
Median	1066	612	1239	972	
Range	30-2485	61-3005	33-3284	30-3284	

*Doctors/nurses include 11 doctors, 81 nurses and 10 technical or clerical staffs.

is of consistent value in individual patients with divergent personalities[12,16,24,28-46,51] in predicting malnutrition, prognosis of patients after surgery, and related complications; this study uses a combination of subjective, biomedical and biochemical parameters (truth-telling, family relationship, surgical procedure, nutritional support, anorexia, QOL, protein-energy metabolism, bodily fluid imbalance, muscle tissue depletion, anemia and immune function) associated with clinical characteristics of malnutrition, in relation to psychometric scores of personality of patients and their support providers, doctors and nurses.

Method

(1) Subjects

Patient and doctor/nurse variables are shown in Table 2. Informed consent was obtained in the form of mutual agreement from each patient with no evidence of other chronic diseases. The patients had received surgery (total or partial resection) and adjuvant chemotherapy, radiation or hormonal therapy in a general hospital and showed no evidence of recurrence at the time of the study. Most patients had certain complications including nutritional problems and complaints. The questionnaires were administered when the patients received their post-surgery follow-up consultations. Days after surgery and other therapies was variable, but this factor did not affect the QOL in its relationship to personality, consistent with previous studies[30,32]. Doctors and nurses who participated in the study, without regard to their specialties, were healthy general hospital staffs, actively engaged in routine clinical and related works. Although their sex distribution was not incompatible, their ages were much younger as compared with patients. Since they are known to influence physical and psychological parameters as well as personality[11,12,15,35,41], subjects' blood types (A, B, O, AB) and seasons of birth (spring, summer, autumn, winter) were recorded and used in the statistical analysis.

The subjects with missing values equal to or less than 3 for the questionnaire responses were used for statistical analyses.

(2) Questionnaires

i) Eysenck Personality Questionnaire (EPQ):

Clinical personality assessment requires refined and broadened patient information having a strong biological underpinning[11-14]. The biological system of the EPQ was derived from the differences observed between clinically (biomedically) meaningful criterion groups[12,24]. Scores for 4 personality traits or dimensions, extraversion (E), neuroticism (N), psychoticism (P) and conformity or lie/dissimulation (L), were obtained using the EPQ, and 11 personality types were constructed using these scores as in the previous studies[30,34,39]. The present questionnaire, the EPQ-25[30-39], was adapted from the English original[40] for rapid and sensitive evaluation of the cancer patients. Psychometric properties of the EPQ-25 were reported in detail elsewhere[38].

ii) Quality of life questionnaire (QOL-20):

Scores for subjective malnutrition parameters (anorexia, asthenia, pain, stress, global QOL) were obtained using the QOL-20 items[30,32,35,87,99]. Wording was adapted for each parameter, except global QOL (see below). The 3-point rating scale was used[32-35].

(3) Blood sample analysis

Scores for biochemical malnutrition parameters were obtained by the blood sample analysis. Patients' venous peripheral blood samples were obtained, during postoperative routine laboratory testing, as in the previous studies[38,39]. They were analyzed by the standard biochemical and immunological procedures, in order to obtain scores for total protein, triglyceride, total cholesterol, glucose, sodium, potassium, erythrocytes, hemoglobin and lymphocytes (see below).

Table 3 The number and percentage of gastric cancer patients receiving truth-telling, family support, total gastrectomy, fluid therapy, hyperalimentation, oral nutrition or radiation therapy (n=53)

	Received		Not received	
	n	%	n	%
Truth-telling	42	79	11	21
Family support	46	86	7	14
Total gastrectomy	17	32	36	68
Fluid therapy	9	17	44	83
Hyperalimentation	19	35	34	65
Oral nutrition	25	48	28	52
Radiation therapy *	2	4	51	96

*Only 2 gastric cancer patients, with Neither type personality (Nei), received radiation therapy due to bone metastasis.

(4) Personality variables: EPQ-25 scores [Predictors]

Patients

E=extraversion (M 17.0, SD 2.8, range 7-24).
   E+, extraverted; E-, introverted
N=neuroticism (M 18.7, SD 2.6, range 8-27)
   N+, neurotic; N-, emotionally-stable
P=psychoticism (M 12.2, SD 2.1, range 7-23)
   P+, toughminded; P-, vulnerable
L=conformity (M 16.0, SD 2.0, range 10-20)
   L+, conformable; L-, naïve

Doctors/nurses

[Diff. from patients: Wilcoxon, 2-tailed]
E=(M 17.4, SD 3.2, range 11-26) [z=1.03]
N=(M 18.8, SD 2.7, range 12-26) [z=0.04]
P=(M 12.8, SD 2.6, range 6-19) [z=2.04 (p<0.05), greater than patients]
L=(M 14.4, SD 1.7, range 10-19) [z=6.92 (p<0.001), less than patients]

Personality types were distinguished based on (patients and doctors/nurses combined) median split of the scores of E, N, P and L. Median scores were E 17, N 18, P 13 and L 17. Patients and doctors/nurses were divided into low E (<17), high E (≥17), low N (<18), high N (≥18), low P (<13), high P (≥13), low L (<17), or high L (≥17). A crossing of the 3 (E, N and P) yielded 8 personality groups (Tol, Int, 6 others), and 2 (E and N, or N and L) yielded further 8 groups (Sang, Chol, Phleg, Mel, Rep, DHA, LA, HA).

Tol, Tolerant (E+ N- P+); Int, Intolerant (E- N+ P-); Nei, Neither (6 other groups combined); Sang, Sanguine (E+ N-); Chol, Choleric (E+ N+); Phleg, Phlegmatic (E-N-); Mel, Melancholic (E-N+); Rep, Repressor (N-L+); DHA, Defensive high-anxious (N+L+); LA, Low-anxious (N-L-); HA, High-anxious (N+L-).

(5) Variables for gastric cancer patients [Predictors]

i) Truth-telling (TT):

The explanation about disease severity and patients' prognosis from doctors to patients was assessed by taking into consideration the truth-telling strategy (telling or not telling) employed by the doctors, in order to analyze the relationship between doctors'/nurses' and patients' personalities for malnutrition, in cancer patients after surgery. The relationship included doctors directly giving to patients true accurate information on diagnosis, pathology, treatment and prognosis, in consideration of patients' personalities.

ii) Family relationship (Fa):

Relationship between patients and their families was analyzed focusing on whether patients were accompanied (supported or intervened) by their spouses, parents, children, grandchildren, and siblings, or otherwise, while they were consulted (receiving TT, informed consent, etc.) by their doctors.

iii) Total gastrectomy (T-gast):

Methods of surgical procedures responsible for the damage to patients, on which malnutrition due to operation depends, was assessed focusing on whether patients received total gastrectomy or partial (distal) gastrectomy.

iv) Fluid therapy (Fluid):

Nutritional support of patients after surgery by usual fluid therapy was contrasted with other regimens, hyperalimentation and normal oral intake.

v) Hyperalimentation (Hyper):

Patients' diet intake was supplemented with vitamins A, B_1, B_2, B_{12}, C, D, iron or calcium. This regimen was contrasted with other regimens.

vi) Oral intake (Oral):

Patients were under normal oral intake of diet. This regimen was contrasted with other regimens.

vii) Radiation therapy:

After surgery, patients with bone metastasis received (those without metastasis did not receive) radiation therapy, which may be responsible for nausea, leucocytopenia and QOL deterioration.

The number and percentage of patients relevant to these variables are shown in Table 3.

(6) Malnutrition parameters [Outcomes]

H. Anorexia="I have a poor appetite" (M 2.7, SD 0.5, range 1-3). QOL-20 item 14.

H. Asthenia="I have no physical strength" (M 2.1, SD 0.6, range 1-3). QOL-20 item 4.

H. Pain="I am in physical pain" (M 2.3, SD 0.7, range 1-3). QOL-20 item 8.

H. Stress="I am suffering from stress" (M 2.1, SD 0.5, range 1-3). QOL-20 item 6.

L. QOL=Global quality of life (M 47.2, SD 4.9, range 32-59). QOL-20, sum of 20 items.

L. TP=Total protein (g/dl) (M 6.8, SD 0.4, range 5.9-8.0)

L. TG=Triglyceride (mg/dl) (M 128.9, SD 83.6, range 42-311).

L. T-cho=Total cholesterol (mg/dl) (M 187.4, SD 32.7, range 115-273).

L. Glu=Glucose (mg/dl) (M 78.6, SD 34.8 range 59-303).

H. Na=Sodium (mEq/l) (M 142.2, SD 2.1, range

Table 4 Cancer patients' personality predicting parameters associated with clinical characteristics of malnutrition: Summary of stepwise linear regression analyses (n=103)

	Anorexia	Asthenia	Pain	Stress	QOL	TP	TG	T-cho	Na	K	Lymph
	-27 E	28 N	20 N	-23 P	29 E	-22 Chol	24 E	21 Sang	-20 L	21 Phleg	32 Tol
	-21 Au	-24 Nei		25 Age	-17 Mel	22 Male		-28 Age	22 Sang	30 Male	21 Nei
		23 Male		-22 A	-20 HA	-36 Gast		-24 O	-19 Gast		-29 Rep
		21 Sp			21 Male	24 A					30 Age
Adj. R^2	.10	.20	.03	.13	.21	.14	.05	.13	.09	.13	.21
F	6.56**	7.38***	3.98*	5.94***	7.79***	5.10***	6.31*	6.08***	4.38**	8.58***	7.62***

A, O; Blood type. Sp, Spring born (Apr-June). Au, Autumn born (Oct-Dec). Gast, Gastric cancer.
Controlling for the effect of TNM stage.
*p<0.05; **p<0.01; ***p<0.001.

138-148)
L. K=Potassium (mEq/l) (M 4.2, SD 0.3, range 3.4-5.2)
L. RBC=Erythrocyte ($\times10^6$/µl) (M 4.1, SD 0.5, range 3.1-5.7)
L. Hb=Hemoglobin (g/dl) (M 14.0, SD 3.9, range 9.3-17.8).
L. Lymph=Lymphocyte ($\times10^3$/µl) (M 1.6, SD 0.5, range 0.6-3.0)
Anorexia, Asthenia, QOL=Principal characteristics of malnutrition.
Pain, Stress=Impeding factors of food intake.
TP, TG, T-cho, Glu, Na, K, RBC, Hb, Lymph=Clinical characteristics of malnutrition.
H=Higher score signifies malnutrition.
L=Lower score signifies malnutrition
(cf. Table 1, for references[1-10,22,23,26,28,29,49-86])

(7) Statistical analysis

A series of stepwise linear regressions (0.05 criterion to enter) was used to test the hypothesis that patients' (Table 4) and doctors'/nurses' personality traits and types and other variables (Table 5) are associated with cancer patients' malnutrition parameters. These malnutrition parameters were used as outcomes, and personality and variables for gastric cancer patients were predictors. Data in Tables 4 and 5 are standard regression coefficients (decimal point omitted) of personality and other variables entered into the final model (p<0.05-0.001). Variables removed at the final step (not included in the final model) are omitted in the tables for clarity. The complete statistical analysis was performed by using SPSS software package Version 9.0 (SPSS Inc, Chicago, Ill., USA, 1999).

Results and discussion

Patients' personality predicting nutritional parameters (Table 4)

Personality trait score of extraversion (E) was associated negatively with anorexia and positively with global QOL and triglyceride (TG) levels, indicating that intro-verted patients are more likely to suffer from malnutrition. Neuroticism (N) score was associated positively with asthenia and pain, signifying that neurotic patients are more likely suffering from malnutrition. While psychoticism (P) score was negatively associated with stress, indicating that vulnerable patients are more likely suffering from malnutrition. Conformity (L) score was also associated negatively with sodium (Na) level, signifying that patients who are naïve (not conforming themselves to the ways of others, such as doctors/nurses) are more likely to suffer from malnutrition.

Personality types of choleric and sanguine predicted lower total protein (TP) or higher total cholesterol (T-cho) level, suggesting that unstable-extraverts are more likely, but stable-extraverts are less likely, suffering from malnutrition. In contrast, tolerant patients and phlegmatic patients predicted higher lymphocyte (lymph) or potassium (K) level, signifying that patients with these personality types are less likely to suffer from malnutrition.

Doctors'/nurses' personality, truth-telling, family relationship, type of surgery, nutritional support and radiation therapy, predicting nutritional parameters, according to patients' personality (Table 5)

In Tolerant type patients: doctors'/nurses' personality score of P predicted greater pain and lower QOL, E score predicted higher sodium and lower potassium levels, and oral intake predicted higher QOL; suggesting that Vulnerable and Introverted doctors/nurses and normal oral nutrition are more likely to alleviate malnutrition-related morbidity and QOL deterioration leading to better prognosis after surgery, in this type of patients.

However, among Intolerant type patients: doctors'/nurses' E score predicted lower glucose and higher sodium levels, P score predicted lesser erythrocyte count, total gastrectomy predicted higher total protein, oral intake and fluid therapy predicted higher sodium or potassium levels; signifying that Introverted and Vulnerable doctors/nurses, total gastrectomy and nutritional support by usual fluid therapy (but not normal oral intake) may be alleviating protein-energy malnutrition, bodily fluid

Table 5 Doctors'/nurses' personality, truth-telling, family support, total gastrectomy, oral nutrition, hyperalimentation and fluid therapy predicting parameters associated with clinical characteristics of malnutrition, according to patients' personality

Tolerant (n=9)				Intolerant (n=16)					Neither (n=78)		Sanguine (n=23)		Choleric (n=28)
Pain	QOL	Na	K	TP	Glu	Na	K	RBC	Anorexia	T-cho	TP	Lymph	Lymph
35 P	-49 P	27 E	-83 E	59 T-gast	-56 E	65 E	69 LA	-40P	-33 Rep	-30 Tol	63 E	48 L	-34 L
51 Rep	-69 Rep	-61 Int	48 Nei			83 Int	63 Fluid		48 TT	30 Rep			-48 T-gast
	17 Oral					40 Oral			28 T-gast	-30 T-gast			

Adj. R²
| .91 | .95 | .97 | .96 | .30 | .27 | .82 | .69 | .49 | .22 | .22 | .36 | .45 | .35 |

F
| 27.22** | 50.37*** | 92.24*** | 86.98*** | 7.44* | 6.41* | 13.81*** | 12.33*** | 8.19*** | 5.67** | 5.63** | 13.50*** | 10.13*** | 8.20** |

Phlegmatic (n=29)	Melancholic (n=23)							Repressor (n=20)			
K	Anorexia	Asthenia	Stress	Na	Hb	Anorexia	Pain	TP	T-cho	Glu	Lymph
-67 Fa	38 N	-62 L	44 TT	32 E	40 DHA	-49 L	40 LA	49 L	-54 Tol	85 Tol	36 E
	41 Nei			-42 HA	-45 Oral	81 Nei	-45 Fluid		-61 T-gast	-56 Fluid	-69 Sang
						-31 Phleg					

Adj. R²
| .41 | .32 | .44 | .16 | .59 | .60 | .70 | .36 | .20 | .45 | .37 | .57 |

F
| 14.41*** | 6.12** | 9.50*** | 5.03* | 11.56*** | 11.98*** | 16.06**** | 5.78* | 5.67* | 8.62*** | 6.60** | 9.24*** |

Defensive high-anxious (n=28)				Low-anxious (n=23)						High-anxious (n=23)		
Anorexia	TG	Na	K	Anorexia	Asthenia	Pain	Stress	Glu	K	Anorexia	TG	Na
34 P	46 L	-42 L	-49 Rep	-48 P	-42 P	-37 E	-31 E	49 E	-65 Int	42 E	-38 E	-45 P
-64 L			-43 Hyper				82 Phleg	-35 HA	87 Mel			
49 Chol							-85 Rep	-46 T-gast	-43 T-gast			

Adj. R²
| .40 | .30 | .29 | .30 | .44 | .14 | .34 | .81 | .59 | .47 | .14 | .61 | .16 |

F
| 7.07*** | 6.69** | 6.68** | 6.82** | 6.66** | 4.50* | 6.71** | 24.64*** | 8.89*** | 7.55** | 4.43* | 12.28*** | 5.29* |

Stepwise linear regression analysis.
Analyses of the data are based on entire patients (Table 2), except for those including TT, Fa, T-gast, Fluid, Hyper, Oral, which are based on gastric cancer patients (Table 3). Controlling for the effects of age, sex, cancer site, TNM stage, blood type and season of birth.

Table 6 Intercorrelations (convergent validity) of parameters associated with clinical characteristics of cancer malnutrition, as a function of personality

	Asthenia	Pain	QOL	TP	TG	T-cho	Glu	Na	K	RBC	Hb	Lymph
Anorexia	31		-42	-28				[Sup]				
Asthenia		26	-62				-23		-32			
Pain			-40									
Stress			-42						-25	-26		23
TP				27	36		-24		25	31		
TG					39		-25			26		
T-cho							-24			34		
K												[Sup]
RBC											52	
Correlation as a function of personality (Zero order partials)												
Anorexia	26		-36	-31				29				
Asthenia		22	-58				-24		-30			
Pain			-41									
Stress			-36						-32	-22		[En]
TP				24	34		[En]		[En]	27		
TG					36		[En]			[En]		
T-cho							[En]			31		
K												29
RBC											51	
Effect of personality on correlation removed (Controlling for scores of E, N, P, L)												

Partial correlations (decimal point omitted) df=69-87, 2-tailed. $P<0.05$-0.001.
(Non-significant results are omitted for clarity)
[Sup], Personality suppresses the correlation.
[En], Personality enhances the correlation.

imbalances, muscle tissue depletion and cancer-related anemia after surgery, in patients with Intolerant type of personality.

In addition, in Neither type patients: doctors'/nurses' Repressor type of personality predicted lower anorexia, truth-telling and total gastrectomy predicted greater anorexia; suggesting that Repressive doctors who do not tell the truth about the disease (deceiving the patients) in consideration of patients' personalities and partial (distal) gastrectomy are more likely to alleviate malnutrition (appetite loss) in this type of patients. While Tolerant type of doctors/nurses and total gastrectomy predicted lower level, and Repressive type predicted higher level, of total cholesterol; signifying that Intolerant (not Tolerant) and Repressive doctors/nurses and partial (not total) gastrectomy are more likely alleviating malnutrition (lipid metabolism imbalances) in this type of patients.

In Choleric patients: doctors'/nurses' L score and total gastrectomy predicted lower lymphocyte level, signifying that Conformable doctors/nurses and total gastrectomy are less likely to alleviate malnutrition-related morbidity (deteriorated immune function) in this type of patients. In Phlegmatic patients: however, relationship with families predicted lower potassium level, suggesting that patients with this type of personality, who are accompanied (intervened or over-protected, preventing normal physical exertion) by their families for doctors' consultation are more likely to suffer from malnutrition (muscle tissue depletion), regardless of doctors' personality. In Melancholic patients: doctors'/nurses' personality score of N, truth-telling and oral intake of nutrition predicted higher anorexia, stress or lower hemoglobin levels, signifying that Neurotic doctors/nurses, explanation (telling the truth without giving hope) about disease severity and patient prognosis and oral intake of nutrition are less likely to alleviate anorexia, emotional stress or anemia after surgery, in this type of patients. Nutritional support by hyperalimentation also predicted malnutrition, lower potassium level or muscle tissue depletion, in patients with specific type of personality, Defensive high-anxious who demand or claim many, in relation to doctors'/nurses' personality of Repressor type who comply well with others' needs.

Two gastric cancer patients received radiation therapy (total dose: 20, 50 Gy) due to bone metastasis. Side effects of radiation, anorexia, nausea, leucocytopenia, etc., affecting the QOL could be speculated by comparing their global scores on the QOL-20 questionnaire (38 and 41, respectively) with those of other patients not receiving the radiation (mean 47.2, SD 4.9).

Interrelations (convergent validity) of parameters associated with clinical characteristics of malnutrition, as a function of personality (Table 6)

When malnutrition parameters were correlated as a function of personality (zero order partials): anorexia correlated positively with asthenia which in turn positively correlated with pain. These 3 parameters and stress all negatively correlated with global QOL, indicat-

ing that these 4 parameters are predictive of impaired QOL. Anorexia negatively correlated with total protein with which triglyceride, total cholesterol, potassiun and erythrocytes positively, but sodium negatively, correlated. Stress correlated negatively with potassium and erythrocytes but positively with lymphocytes. While asthenia negatively correlated with glucose and potassium, signifying that muscle tissue depletion and energy source imbalances are responsible for loss of bodily strength. These correlations suggest that cancer patients' malnutrition involves protein-energy undernutrition, losses in skeletal muscle compartment (containing a large amount of potassium, which may account for the changed body composition), bodily fluid imbalances (linked with sodium level) and anemia-related morbidity[39, 52, 63]. Positive correlation between stress and lymphocyte level indicates that emotionally stressed patients by cancer perception (truth-telling) may show enhanced immune function (higher lymphocyte level), under the influence of specific type of personality.

When effect of personality on correlation was removed (controlling for scores of E, N, P, L): positive correlation between stress and lymphocyte level disappeared. This suggests that immunoenhancing effect of stress is mediated by these personality traits, consistent with previous studies on stress-inoculation effects of personality on immune function[43,44,88,89]. Negative correlation of Na and TP, TG or T-cho, and positive correlation of K and TP, also disappear, if personality is controlled. Hence, this further suggests that protein-energy malnutrition, muscle tissue depletion and bodily fluid imbalances are associated with each other, under the influence of these personality traits. And these malnourished conditions are all associated with poor QOL.

General discussion

Malnutrition, anemia-related complications and impaired immune function are major morbidity of cancer patients[22,28,38,39]. Their rapid, non-invasive and cost-effective assessment, by valid and highly reliable personality scores and subjective responses on questionnaires with appropriate sensitivity and specificity, is clinically important, because they can reveal easily the patients who are at risk of this morbidity (metabolic, anemic, immunologic) earlier than any other means of assessment. The present results of patients' personality (Table 4) show that cancer patients who are at risk of developing general malnutrition, behavioral and biochemical, are characterized by introversion (E-), neuroticism (N+), vulnerability (P-) and lack of conformity (L-); in other words, by the EPQ-25 scores of less E, P and L and greater N. These personality characteristics of cancer patients [suggesting a risk of malnutrition] are consistent with those at risk of anemia, impaired immune function and QOL deficit[30-39].

The results of doctors'/nurses' personality (Table 5) show that doctors/nurses who are more likely to alleviate risk of developing malnutrition (behavioral, biochemical, anemic, immunologic) are characterized by introversion (E-) and vulnerability (P-)[suggesting a protection against malnutrition] if patients are of tolerant type (high E and P and low N scorers) or intolerant type (low E and P and high N scorers), depending on nutritional parameters. On the contrary, doctors/nurses who are less likely to alleviate such a risk are characterized by neuroticism (N+) and lack of conformity (L-), if patients are of other personality types than tolerant or intolerant.

These results indicate that patients' personality interacting with docrors'/nurses' personality, not either personality alone, for each parameter (anorexia, asthenia, pain, stress, TP, TG, T-cho, Glu, Na, K, RBC, Hb or Lymph) is important as a differential factor of malnutrition, improving or deteriorating QOL and prognosis of patients after surgery. Doctors'/nurses' and patients' "personality relationships" responsible for "alleviating malnutrition" may vary with "nutritional parameters" associated with reduced macro-/micro-nutrient intake, protein-energy metabolism, bodily fluid imbalances, muscle tissue depletion, anemia and immune function, as well as explanation about disease from doctors to patients, relationship between patients and their families, methods of surgical procedures and nutritional support of patients after surgery.

It may be argued that explanation about disease severity and patient prognosis from High-anxious (as opposed to Repressive) doctors to Neither type patients is less likely to alleviate malnutrition-related morbidity. By the same token, the relationship between patients and their families, who may be intervening over-protectively between patients and doctors, may influence malnutrition in Phlegmatic patients, independent of doctors'/nurses' personality. It is possible that patients with Choleric personality receiving total gastrectomy by doctors with Conforming personality is less likely to attain better prognosis after surgery. It is possible, however, that nutritional support, for Tolerant type patients, with normal oral intake by Vulnerable doctors/nurses is more likely alleviating malnutrition. Although hyperalimentation support by Repressive doctors/nurses is less likely to alleviate malnutrition in Defensive high-anxious patients, usual fluid therapy by Low-anxious doctors/nurses is more likely alleviating malnutrition-related morbidity among Intolerant patients.

Explanation about disease severity and patients' prognosis from doctors with Repressive type personality may cause greater stress or anorexia in Melancholic and Neither type patients, leading to poor nutritional status. Although total gastrectomy predicted poor nutritional status in 4 personality types of patients (Neither, Choleric, Repressor and Low-anxious); this major sur-

gery predicted higher total protein level among Intolerant patients, regardless of doctors' personality. Doctors' explanation about diagnosis, pathology, treatment or survival may be responsible for greater stress and anorexia leading to malnutrition in Melancholic or Neither type patients; while total gastrectomy seems to be associated with better nutritional status among "Intolerant patient", but not other personality types, independent of doctors' personality. It is possible then that total gastrectomy may cause greater stress inoculation (stress alleviating) effect of "Intolerant personality", which may be responsible for better adaptation, Pavlovian protective conditioning or resilience, bouncing back to normal protein metabolism from the damage of surgery[12,24,31,42-44,89,105-108]. Further data of these issues are reported elsewhere[99-104].

Intercorrelations (convergent validity), as a function of personality, of parameters associated with psychological, biochemical, anemic and immunologic facets of malnutrition (anorexia, asthenia, stress, pain, QOL, total protein, triglyceride, total cholesterol, glucose, sodium, potassium, erythrocytes, hemoglobin and lymphocytes) (Table 6) show that malnourished patients may have a poor QOL, protein-energy undernutrition, loss of muscle composition, bodily fluid imbalances, anemia-related morbidity and altered immune function. Their stress-related immune function, and anemia (reduced oxygen supply) responsible for energy metabolism, may be influenced by personality. In fact, if personality factors were controlled, positive correlations between stress and lymphocyte count, and triglyceride level and erythrocyte count, disappeared (they were no longer significant, $p>0.05$), suggesting that stress-inoculation effect of personality on immune function (resulting in immunoenhancement), and reduced energy metabolism caused by anemia-related complications, are mediated by personality traits of E, N, P and L. This inoculation effect (stress alleviation effect of personality, introversion, vulnerability or neuroticism) on immune function is consistent with total gastrectomy (damaging stress to the patient) alleviating protein malnutrition among Intolerant type patients but not other personalities (Table 5), as well as previous studies of personality and stress in cancer patients[42,43,88,89].

Malnutrition is a complex multiphasic syndrome associated with psychological, biochemical and immunologic abnormalities. It is influenced by dietary behavior and emotional stress (perception of cancer, due to explanation from doctors, awareness of one's own disease, etc.), impeding food intake, and subsequent nutritional support inadequacy or metabolic alterations, and vice versa. Previous animal and human studies have shown that emotional stress impedes dietary behavior, causes loss of body weight and physical activity, affects appetite for specific macro- and micro-nutrients (protein, energy sources, inorganic elements, etc.), and influences metabolic abnormalities of nitrogen, glucose, sodium or potassium related to these specific nutrients[27,90-98]. A wide range of distribution of these nutritional parameters among the subjects suggested dichotomy between stress-prone (sensitive to emotional stress, responsible for feeding depression or imbalances) and stress-resistant (resilient) animals, which could be equivalent to human types of personality. The results of the present study of cancer patients could be interpreted in terms of this [emotional stress-reduced food intake] link (Figure 1), causing anorexia, resulting in malnutrition (protein-energy undernutrition, muscle tissue depletion, bodily fluid imbalances, anemia and impaired immune function), as a function of individuality or personality.

Tailor-made strategies for assessing and improving this morbidity, cancer malnutrition or cachexia, a complex multifactorial/multiphasic syndrome, need to identify patients' personality characteristics or individuality. Although an adequate prospective study is required for final validation, it may be concluded that cancer patients' personality score is an easy, rapid, non-invasive and cost-effective diagnostic tool for identifying which patient is at potential risk of developing malnutrition. Doctors'/nurses' personality, truth-telling strategy, relationship with families, surgical procedure and also nutritional support, if they are congenial to patients' personality, may alleviate this risk.

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