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ORIGINAL ARTICLE

Exploring Malnutrition in Systemic Sclerosis: Clinical Profiles, Laboratory Markers, and Contributing Factors

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ABSTRACT

Background: The gastrointestinal tract (GIT) is the most affected system in Systemic sclerosis. This has a great impact on food intake and intestinal absorption resulting in gradual increase in nutritional deficiencies which has significant negative consequences on the human body. We aimed from the current study to evaluate the nutritional status in patients with systemic sclerosis (SSc) and all related risk factors that may increase the risk of malnutrition. **Methods:** This case-control study was carried out on 48 subjects attending the clinics of Rheumatology and Rehabilitation Department, Faculty of medicine, Zagazig University Hospitals. Group (1): 24 scleroderma patients and group (2): 24 healthy age-sex matched individuals. Nutritional status was assessed using Malnutrition Universal Screening Tool (MUST), disease activity using Modified Rodnan skin score (mRSS) and Scleroderma Assessment Questionnaire (SAQ), assessment of mouth disability by Mouth Handicap in SSc Questionnaire (MHISS) and serum albumin, zinc (Zn) and selenium (Se) were measured.**Results:** About 41.7% of our patients (10 of 24) were at high risk of malnutrition and about 21% of them (5 of 24) were at moderate risk. High risk group showed lower levels of Zn, Se and albumin and it showed higher degrees of weight loss in the previous 6 months. **Conclusion:** Our study found that a significant portion of SSc patients is at high risk of malnutrition, associated with lower BMI, serum zinc, and selenium levels. Malnutrition risk correlated with wasting, high ESR, and reduced serum nutrients. These findings emphasize the need for regular nutritional assessment in SSc management.

Keywords: Malnutrition; Systemic Sclerosis; Serum Selenium; Serum Zinc

INTRODUCTION

As a chronic autoimmune disease, the most noticeable aspect of Systemic Sclerosis (SSc) is progressive fibrosis, which causes severe harm (up to) multiorgan failure (i.e., gastrointestinal tract (GIT), skin, joints, and among many others). It mostly impacts women with female: male ratio may reach up to 10:1 [1].About 90% of SSc patients show GIT affection. Any part of GIT may be affected; however, oral cavity is the commonest site to be affected, mainly with

microstomia and xerostomia [2]. Esophageal involvement, with weak or absent peristalsis and reduced pressure of lower esophageal sphincter, results in dysphagia to solids and gastroesophageal reflux disease (GERD). So, GIT involvement has a great impact on food intake and intestinal absorption resulting in gradual increase in nutritional deficiencies [3]. In addition to GIT involvement, numerous other risk factors, such as depressive disorders, functional limitations, heart failure, lung fibrosis, and inflammation, may have an impact on nutritional level [4]. The body needs the right balance of micronutrients for healthy immunological function, with variable needs at different stages of life [5]. Around fifty percent of patients with SSc were deficient in one micronutrient-at least-, attributing this paucity to autoimmune nature of the disease and may contribute to its etiology. Micronutrient deficiencies were commonly including Zn, Se, vitamin D and vitamin B12.these deficiencies may impair immune function, wound healing and contribute to disease progression [6].All these factors make SSc patients at an elevated risk of malnutrition. Malnutrition is a nutritional condition in which a lack of, an excess of or an imbalance of different nutrients can have significant negative consequences on human body [7].

To our knowledge, no Egyptian studies assessed malnutrition and its risk factors in SSc patients. So, the aim of our study was to evaluate the nutritional status in patients with SSc and all related risk factors that may increase the risk of malnutrition.

METHODS

The sample size was determined based on statistical power (80%) and confidence interval (95%). Assuming that serum level of zinc was 66.3 ±16.9 in cases and 79.6 ± 15.5 in control. The calculated sample size was 48 subjects. They were enrolled in this case-control study during the period from (April 2019 till April 2020) and were divided into 2 groups. Group 1 included 24 patients of scleroderma who attended to Rheumatology and Rehabilitation Department, Faculty of Medicine, Zagazig University Hospitals – Egypt, 21 patients of them were females and the other three patients were males, aged more than 18 years old according to the American College of Rheumatology (ACR) criteria for SSc [8] and group 2 included 24 healthy age-sex matched control persons. After obtaining the approval of the Institutional Review Board (IRB#5342) of Faculty of Medicine, Zagazig University in agreement with the 1979 Declaration of Helsinki, all participant provided an informed consent to the study committee.

Patients with intentional weight loss, other rheumatologic diseases, any type of cancer, endocrinal disorders, or infection (like tuberculosis or hepatitis) were excluded.

1)Clinical assessments: In addition to clinical history (stressing on age, disease duration and subtype of scleroderma) and clinical examination (general, as well as musculoskeletal examination), SSc patients were assessed using the following:

a) The Modified Rodnan Skin Score (MRSS): MRSS was employed as an outcome and skin thickness measure. The maximum score was modified to 51 points by evaluating skin tightness on a 0–3 scale across 17 different body regions. Furthermore, a Visual Analog Scale (VAS) was used to evaluate the change in the skin region involved during the last 30 days [9].

b) The Scleroderma Assessment Questionnaire (SAQ): A 23 question self-assessment questionnaire used by SSc patients to measure their illness condition. The answers were weighed on a 0–3 scale. Index of Disease Status (IDS)- total score of the questionnaire / number of questions- was then obtained. Therefore, SAQ is a sensitive assessment

of the degree of various organ impairment in SSc patients. In our study SAQ was translated to Arabic, for convenience to our patients. This validity check technique was used to guarantee accurate translation [10].

2) *Evaluation of nutritional status:*

a) Anthropometric assessment: It included height, weight, body mass index (BMI) and upper arm anthropometry and the percentage of weight loss to detect if there is a significant weight loss [11].

b) Dietary assessment: Twenty-four-hours dietary recall is a quick, easy, and economical method that can yield precise intake information. It involves asking each person to recollect the precise foods and drinks they had consumed the previous day. For each subject, the consumed quantities of foods and drinks were estimated in household measures and grams. Then, the collected data were transformed into calories through the complied food composition tables of the Egyptian National Nutrition Institute [12].

c) *Malnutrition Universal Screening Tool (MUST):* it depends on three scores that are BMI, quantity of unintentional weight loss in past 3–6 months, and no nutritional intake for more than 5 days due to acute illness. Also, mid upper arm circumference (MUAC) was measured. The overall risk for malnutrition is then demarcated as low risk (0); medium risk (1); high risk (≥2) of malnutrition. Score between 1 and 2 was assigned to unintentional weight loss and weight status [13].

d) Mouth Handicap in SSc Questionnaire (MHISS): A five-point system is used to evaluate this self-reported, twelve items measure. It assesses mouth affection features (e.g., dry mouth, chewing ability, mouth opening, and overall facial appearance). It is answered according to the. The higher the total score, the higher the magnitude of the problem [14]. In our study, MHISS was translated, and validated by experts before being used for our patients. Patients were given the questionnaire and asked to complete it without additional instructions.

3) *Laboratory assessments:*

Laboratory assessment for each participant included measuring: (a) hemoglobin concentration as part of complete blood picture measured by Sysmex XN-2000 auto-analyzer™ (Sysmex, Kobe, Japan), (b) erythrocyte sedimentation rate (ESR) measured by Vision B analyzer™ (YHLO Biotech diagnostic, China), (c) serum Albumin, fasting serum glucose,C-reactive protein (CRP), serum creatinine, transaminases (ALT and AST), and serum urea nitrogen measured by Cobasc702/8000 (Roche diagnostic™, Germany), (d) anti-topoisomerase (Anti-scl70) using sandwich Enzyme-Linked Immunosorbent Assay (ELISA), Cat.No#E0505Hu (Bioassay Technology Laboratory, Shanghai, China), and (e) anti-nuclear antibodies (ANA) titer and pattern by indirect immunofluorescence technique using NOVA Lite Human epithelial cell 2 (Hep-2)™ (Inova Diagnostics, San Diego, USA). Nutritional assessment included measuring serum zinc (Zn) using end-point colorimetric technique with 5-Bromo-PAPS, Cat.No# MG330 001 (Science & Technology center, Cairo, Egypt), and serum selenium (Se) using Agilent 240 FS Atomic Absorption Spectrometer™ (Agilent Technologies, Australia), equipped with a graphite furnace (electrothermal) atomizer.

Statistical methods:

IBM SPSS 25.0 for windows (SPSS Inc., Chicago, IL, USA) was used to statistically analyze the collected data. The first step was to check for normality of

continuous data using Shapiro Walk test. For comparing two groups, Student's *t*-test was used to compare between normally distributed variables and Mann Whitney *U* test was used for non- normally distributed ones. For more than two groups, ANOVA test was used to compare normally distributed variables and Kruskal Wallis test for non- normally distributed ones. Post-hoc tests (Tukey's HSD and Dunn's test, respectively) were utilized to define the difference between two groups when ANOVA test or Kruskal Wallis test was significant. To assess the relationship between various study variables Spearman's rank correlation coefficient was used. Statistical difference was defined as $P<0.05$.

RESULTS

SSc patients and control group were comparable regarding to age, sex and residence. Whereas BMI, MUAC, recommended dietary allowance, Serum Zn, and serum Se were lower among SSc patients than control group [table 1].

According to GIT involvement, the most common manifestations were dysphagia and epigastric pain affecting 18(75%) patients [table 2].

Most of SSc patients (n=23,95.8%) had +ve ANA with a median titer of 2folds. The most common pattern of ANA was the homogenous pattern 12(50.0%). SSc patients with +ve Anti Scl 70 were 18 (75.0%). The median (range) of serum Zn among SSc patients was 52.5(30-115) µg/dl and that of serum Se was 47(18-48) µg/dl [table 3].

In our study, 41.7% of SSc patients were at high risk of malnutrition and about 20.8% of them were at moderate risk while about 37.5% of our patients were at low risk.

Wasting, epigastric pain, Mouth handicap Score, weight, BMI, MUAC. ESR, serum albumin, serum Zn, and serum Se were the risk factors that were associated with Overall risk of malnutrition (MUST) [table 4].The correlation between the laboratory parameters of nutrition (i.e. serum Zn and serum Se) with other laboratory parameters as well as anthropometric measures and different clinical scores were shown in table 5.

Table 1: Demographic characteristics& nutritional status of SSc patients and control group

Variables	**Studied groups**		**t**	**p-value**
	Cases n=24	**Control n=24**		
Age in years Mean ±SD	41.1±10.7	40.3±10.5	0.28	0.78
Sex *n (%)* Males Females	 3(12.5) 21(87.5)	 3(12.5) 21(87.5)	$\chi^2=0$	1
Residence *n (%)* Rural Urban	 19(79.2) 5(20.8)	 19(79.2) 5(20.8)	$\chi^2=0$	1
Weight(kg) *Mean ± SD*	66.1±16.4	78.8±11.9	3.07	**0.004**
Height (cm) *Mean ± SD*	161.5±7	161.8±6.2	0.13	0.89
BMI *Mean ±SD* Underweight *n(%)* Normal *n(%)* Overweight *n(%)* Obese *n(%)*	25.4±6.3 1(4.1) 10(41.7) 9(37.5) 4(16.7)	30.2±4.7 0 4(16.7) 8(33.3) 12(50)	3	**0.004**

MUAC (cm) *Mean ±SD*	24.3±3.3	29±4	4.5	**0.001**
Recommended dietary Allowance *Mean ±SD*	1667±197	1860±262	2.9	**0.006**
Serum Zinc (µg/dl) *Median(range)*	52.5(30-115)	83(36-128)	U=2.7	**0.007**
Serum Selenium (µg/dl) *Median(range)*	47(18-84)	83(53-128)	U=4.7	**0.001**

Table 2: Clinical characteristics of SSc patients (n=24)

Clinical characteristics	**Present**	
	No.	**%**
Disease duration in years <5 ≥5 *Median (Range)*	 19 5	 79.2 20.8
	2.25 years (6 months-8 years)	
Disease subtype: Diffuse Limited	 21 3	 87.5 12.5
General examination: Lower limb edema Wasting	 10 12	 41.7 50.0
Renal involvement	3	12.5
Pulmonary affected: Dyspnea Interstitial lung disease Pulmonary artery hypertension	 19 19 4	 79.2 79.2 16.7
Cardiac involvement	1	4.2
Gastrointestinal involvement Nausea / Vomiting Dysphagia Epigastric pain Constipation Diarrhea Stool incontinence	 17 18 18 17 11 0	 70.8 75.0 75.0 70.8 45.8 0.0
Cutaneous and vascular examination Raynaud's phenomenon Digital ulcer Pitting scars Telangiectasia Calcinosis Puffiness	 23 11 10 10 7 19	 95.8 45.8 41.7 41.7 29.2 79.2
Modified Rodnan Skin Score (mRSS) *Mean±SD (range)*	26.7±7.7(5-36)	
Musculoskeletal involvement		
Swollen joint count *Median (range)* Tender joint count *Median (range)*	3.5 (0-10) 6 (0-12)	

Deformity Myalgia Arthralgia Mono arthritis Oligo arthritis Polyarthritis	18 23 7 3 4 10	75.0 95.8 29.2 12.5 16.7 41.7
Scleroderma Assessment Questionnaire (SAQ) ID *Median(range)*	1.17(0.26-2.48)	

Table 3: Laboratory characteristics of SSc patients (n=24)

Laboratory test	
ESR (mm/hr) *Median(Range)*	40.5(10-90)
CRP (mg/l) *Median(Range)*	12(1.03-65)
Hemoglobin (g/dl) *Mean ± SD*	12.4±1.5
Fasting serum glucose *Median(Range)*	98(82-240)
Liver function test: Serum AST (U/L) *Median(Range)* Serum ALT (U/L) *Median(Range)* Serum albumin *Mean ± SD*	 22.65 (11.4-42) 23.5 (6.2-56) 3.73±0.47
Kidney function test: Serum urea nitrogen (mg/dl) *Median(Range)* Creatinine (mg/dl) *Median(Range)*	 9.3(3.4-13) 0.8(0.39-1.4)
Serological tests:	
ANA n(%) Positive negative **ANA titer** *Median (Range)* **Detected pattern *n(%)*** Homogenous Nuclear Speckled	 23(95.8) 1(4.2) 2 fold (1fold-5 fold) 12(50.0) 5(20.8) 6(25.0)
Anti-scleroderma70 *n(%)* Positive Negative	 18(75.0) 6(25.0)
Micronutrient Serum zinc (µg/dl) *Median(Range)* Serum selenium (µg/dl) *Median(Range)*	 52.5(30-115) 47(18-48)

Table 4: Risk factors associated with Overall Risk of malnutrition

Variables (n=24)	**Overall risk malnutrition (MUST)**						χ^2	***p***
	Low risk N= 9		**Medium risk N=5**		**High risk N=10**			
Age per years *Mean±SD*	42.7±12.6		36.2±4.5		42.2±11		f=0.66	0.53
Sex, *n(%)* Females Males	8 1	38.1 33.3	3 2	14.3 66.7	10 0	47.6 0	4.6	0.86
Residence, *n (%)* Rural Urban	8 1	42.1 20.0	4 1	21.1 20.2	7 3	36.8 60.0	1.03	0.59
Duration <5years ≥5years	7 2	36.8 40.0	4 1	21.1 20.0	8 2	42.1 40.0	0.02	0.99
Disease duration median (range)	3(1.5-8)		1.5(0.5-7)		2.75(1.5-6)		3.01	0.22
Disease Type, *n (%)* Diffuse Limited	6 3	28.6 100	5 0	23.8 0	10 0	47.6 0	5.7	0.06
Muscle Wasting, *n (%)* Yes No	1 8	8.3 66.7	1 4	8.3 33.3	10 0	83.3 0	17.2 ***P*=0.001**	*(0.99) **(0.002) ***(0.007)
Epigastric pain, *n (%)* Yes No	4 5	22.2 83.3	4 1	22.2 16.7	10 0	55.6 0	7.9 ***P*=0.019**	*(0.19) **(0.007) ***(0.67)
Telangiectasia, *n (%)* Yes No	3 6	30.0 42.9	2 3	20.0 21.4	5 5	50.0 35.7	6	0.8
Interstitial lung disease, *n (%)* Yes No	6 1	31.6 20.0	5 2	26.3 40.0	8 2	42.1 40.0	2.2	0.34
Pulmonary hypertension: *n (%)* Yes No	2 7	50.0 35.0	1 4	25.0 20.0	1 9	25.0 45.0	0.6	0.8
Heart Involvement, *n (%)*	1	100.0	0	0	0	0	1.74	0.4
Weight loss during last 6 months, *n (%)* ≥10%(n=11) <10%(n=13)	0 9	0.0 69.2	1 4	9.1 30.8	10 0	90.9 0.0	20.8 ***P*=0.001**	*(0.71) **(**0.002**) ***(**0.007**)
MHISS, *median (range)*	23(8-35)		26(11-29)		32.5(23-43)		KW=8.6 ***P*=0.014**	*(0.95) **(**0.013**) ***(**0.015**)
SAQ, *median (range)*	1.04(0.26-1.61)		0.95(0.78-1.78)		1.48(0.96-2.48)		KW=3.3	0.2
BMI, *Mean±SD*	29.4±6.7		27.2±5.3		20.8±3		f=6.9 **P=0.005**	*(0.44) **(**0.002**) ***(**0.036**)
MUAC, *Mean±SD*	26.2±2.4		25.8±4		21.75±1.8		f=8.1 **P=0.002**	*(0.77) **(**0.001**) ***(**0.01**)
Serum Zinc, *median (range)*	72(48-92)		74(38-115)		38.5(30-56)		KW=12.8 ***P*=0.002**	*(0.74) **(**0.001**) ***(**0.017**)

Serum Selenium, *median (range)*	67(48-84)	45(24-78)	30(18-74)	KW=9.5 ***P*=0.008**	*(0.26) **(**0.002**) ***(0.198)
Serum albumin, *Mean±SD*	3.8±0.46	4.1±0.3	3.47±0.42	f=4.2 ***P*=0.029**	*(0.23) **(0.08**) ***(**0.01**)
ESR, *median (range)*	28(10-70)	20(15-85)	60(22-90)	KW=6.05 ***P*=0.049**	*(0.38) **(**0.045**) ***(**0.049**)

*(Low & medium risk), ** (Low & high risk), *** (medium & high risk).X^2 : Chi square test , f: ANOVA test **,** KW: Kruskal Wallis test, MUCA: mid upper arm circumference, MUST: Malnutrition Universal Screening Tool, MHISS=Mouth Handicap in SSc, BMI: body mass index, SAQ: Scleroderma Assessment Questionnaire index of disease status, ESR: Erythrocyte sedimentation rate

Table 5: Correlations of serum Zinc & Selenium with different disease and nutritional status characteristics in SSC patients

Variables	**Serum Zinc µg/dl**		**Serum Selenium µg/dl**	
	r	***p***	**R**	***p***
Age	-0.287	0.173	-0.146	0.496
Disease duration	-0.357	0.086	-0.257	0.226
Anthropometric measures				
Weight	**0.736**	**0.001**	**0.553**	**0.005**
Height	0.348	0.096	0.272	0.199
BMI	**0.548**	**0.006**	0.378	0.069
MUAC	**0.678**	**0.001**	**0.516**	**0.01**
Weight loss during last 6months	**0.574**	**0.003**	**0.661**	**0.001**
Percentage of dietary intake	0.197	0.357	0.239	0.26
Clinical scores				
MUST score	**-0.614**	**0.001**	**0.588**	**0.003**
MHISS	0.383	0.065	**0.482**	**0.017**
MRSS	0.309	0.142	0.271	0.2
SAQ	0.011	0.96	0.214	0.314
Laboratory findings				
Fasting serum glucose	0.238	0.263	0.401	0.052
ESR	0.24	0.26	**0.485**	**0.016**
CRP	0.17	0.428	0.245	0.248
Serum urea nitrogen	0.035	0.872	0.121	0.573
Serum Creatinine	0.062	0.775	0.21	0.324
AST	0.093	0.666	0.116	0.59
ALT	0.215	0.314	0.067	0.754
Serum albumin	**0.495**	**0.014**	0.294	0.163
Hemoglobin	0.019	0.928	0.053	0.806

BMI: body mass index, MHISS=Mouth Handicap in SSc, MUST: Malnutrition Universal Screening Tool, SAQ ID= Scleroderma Assessment Questionnaire index of disease status, SSCQOL=Systemic Sclerosis Quality of Life. mRSS=modified Rodnan skin score, FBS= fasting blood sugar, HB= hemoglobin, ESR= Erythrocyte sedimentation rate, CRP= C-Reactive protein, ALT= Alanine transaminase, AST= Aspartate transaminase, Se= selenium, *P* value< 0.05 statistically significant

DISCUSSION

As an autoimmune disorder, SSc is characterized by disturbance in both cell-mediated and humoral immunity with the affection of skin and internal organs by deposition of excess collagenous fibers [3]. Patients with SSc are at an increased risk of malnutrition and this has an adverse impact on disease progression [15]. The present study aimed to evaluating the nutritional status in Egyptian patients with SSc and other related risk factors that may increase the malnutrition risk.

According to the Malnutrition Universal Screening Tool (MUST), 41.7% of our patients are at high risk of malnutrition, 21% are at moderate risk and 37.5% of them are at low risk of malnutrition. Earlier studies by Preis et al. [16] and Caimmi et al. [17] reported lesser percentages: 10.9% and 7.8% respectively are at high risk for malnutrition and 14.7 % and 12.8 % respectively are at medium risk. Compared to these studies, the malnutrition risk in our study was higher because patients have more severe diseases, and more severe GIT symptoms, as the severe GIT affection in cases of SSc, the higher the degree of malnutrition.

Considering the individual GIT complaints that show higher malnutrition risk, we found that the most common symptoms in our patients are dysphagia and epigastric pain, and those who suffered from epigastric pain were more liable to be at high risk of malnutrition than others (P=0.02). But Türk et al. [18] in their study found that risk of malnutrition was not linked to either gastric or esophageal involvement, claiming that intestinal involvement and microstomia are the most important contributors. Also, Baron et al. [19] reported substantial correlations between MUST scores and early satiety, nausea, constipation, and diarrhea. Then again, Preis et al. [20] reported that patients with and without malnutrition experienced similar levels of GIT involvement. Caimmi et al. [21] found that malnourished patients did not have more significant GI affection. The disparities between the studied populations and the use of various methods to assess nutritional status could account for the discrepancy between studies.

In this study, age, sex, and disease duration among SSc patients were not related to malnutrition. Türk et al. [18] also reported similar observations. Yet, Baron et al. [19] revealed that the risk of malnutrition rose with shorter illness duration as patients with diffuse cutaneous disease, who are severely ill, commonly lose weight early in their illness and afterwards stabilize and sometimes start gaining weight. Current study shows that the risk of malnutrition did not differ among different disease subtypes. Caimmi et al. [21] and Preis et al. [20] reported the same results, but Baron et al. [19] found higher MUST scores in patients with diffuse SSc. This may be attributed to the more severe organ involvement in diffuse SSc.

It is also known that nutritional insufficiency may result in weight loss and muscle atrophy, but this may be attributed also to disease severity and reduced physical ability [22]. In our study, about 50% of our SSc patients had muscle wasting and it was apparent that 83.3% of people with wasting were significantly associated with high risk of malnutrition. According to the anthropometric measures, our study shows that anthropometric measures (i.e. weight, BMI and MUAC) and the risk of malnutrition were statistically significantly related. However, Wojteczek et al. [23] stated that low BMI alone is not useful in assessing nutritional status as it may limit the number of candidates in the study, but it can be considered as an early marker of the nutritional status. So, assessment of body composition is necessary as it may indicate SSc patients in the early stages of malnutrition. By comparing results among the studied groups, we noted that BMI, MUAC, and recommended dietary allowance

were lower in SSc patients than the control group. Similarly, Harrison et al. [24] proved that MUAC was significantly lower in patients than in control subjects. They also reported higher BMI in the female patients. They justified that by the increased thickness of skin in SSc patients.Regarding micronutrients and trace elements deficiency in autoimmune diseases and their impact on nutritional status, our study conveyed a sturdy association between the low levels of serum zinc, selenium and albumin and the overall risk of malnutrition. By comparing results of SSc patients and control group, we found that serum zinc and selenium levels were lower in SSc patients than that in control subjects. Similarly, Läubli et al. [25] found that most of the patients with recognized SSc and less than half of those with early stage SSc appeared deficit in micronutrients and/or prealbumin. Nguyen et al. [26] in their review article stated that vitamin deficiency (especially vitamin D) is commonly reported in SSc patients followed by serum zinc, selenium and iron deficiencies. This data implies that nutritional problems could be detected by measuring macro-/ micronutrients in serum even before the appearance of clinical manifestation.
In our study, there was a strong correlation between serum zinc level and serum selenium with low BMI, less MUAC and weight loss denoting that their deficiency is associated with higher risk of malnutrition according to MUST score. In a previous study of Laubli et al. [25] they detected that low BMI < 20 kg/m2 was relatively frequent in patients with any nutrient's deficiencies. The present study also demonstrated that higher ESR level was strongly associated with high risk of malnutrition according to MUST score. Laubli et al. [25] reported similar findings. They stated that ESR was significantly higher in SSc patients with low levels of zinc or prealbumin because their chronic deficiency may trigger the inflammatory process resulting in high ESR level.

As for the influence of oropharyngeal and facial abnormalities on SSc patients, our study shows that there was a significant gradual increase of Mouth Handicap Score (MHISS) in SSc with increased overall risk of malnutrition level (P=0.014). Also, a higher score of MHISS was found to be associated with low levels of serum selenium (P=0.017). This explained by Crincoli et al. [27], as contracted oral aperture in microstomia is accompanied by diminished oral feeding and inadequate dental care, leading to malnutrition of the patient.Microvascular damage, with its different clinical presentations, is one of the main characteristics of SSc. So, we studied its effect on the overall risk of malnutrition in SSc patients. Fortunately, our study showed no association between vascular involvement and the risk of malnutrition. Türk et al. [18] also found no association between malnutrition and previous digital ulcers (DUs). Additionally, Caimmi et al. [21] stated that either current or previous DUs had no significant association with malnutrition. On the other hand, Delano and Moldawer [28] reported that patients with multiple DUs may develop cachexia as a result of a combination of anorexia, disability, eating difficulties, and release of pro-inflammatory mediators.
Finally, we can assume that the risk factors of malnutrition in SSc patients were GIT involvement mainly epigastric pain and dysphagia, low BMI, weight loss, reduced dietary intake due to oropharyngeal abnormalities and reduced oral aperture and micronutrients deficiency especially serum Zn and serum Se. Our study had some limitations; because of scarcity of SSc, the sample size was small. Hence, the results cannot be generalized to the entire SSc population. Moreover, we did not use a specific tool for assessment of GIT alone to clarify to what extent it can implicate nutritional status. Likewise, we should take into consideration that MUST is preferred to be used in acute

diseases with weight loss more than in slowly progressive ones.

Conclusion:

Our study found that a significant portion of SSc patients is at high risk of malnutrition, associated with lower BMI, serum zinc, and selenium levels. Malnutrition risk correlated with wasting, high ESR, and reduced serum nutrients. These findings emphasize the need for regular nutritional assessment in SSc management.

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REFERENCES

1. Kowal-Bielecka O, Fransen J, Avouac J, et al. Update of EULAR recommendations for the treatment of systemic sclerosis. *Ann Rheum Dis*. 2017;76(8):1327-39. doi:10.1136/annrheumdis-2016-209909
2. Luquez-Mindiola A, Atuesta AJ, Gómez-Aldana AJ. Gastrointestinal manifestations of systemic sclerosis: An updated review. *World J Clin Cases*. 2021;9(22):6201-17. doi:10.12998/wjcc.v9.i22.6201
3. McFarlane IM, Bhamra MS, Kreps A, et al. Gastrointestinal Manifestations of Systemic Sclerosis. *Rheumatol Sunnyvale Calif*. 2018;8(1). doi:10.4172/2161-1149.1000235
4. Dupont R, Longué M, Galinier A, et al. Impact of micronutrient deficiency & malnutrition in systemic sclerosis: Cohort study and literature review. *Autoimmun Rev*. 2018;17(11):1081-89. doi:10.1016/j.autrev.2018.05.010
5. Maggini S, Pierre A, Calder PC. Immune Function and Micronutrient Requirements Change over the Life Course. *Nutrients*. 2018;10(10). doi:10.3390/nu10101531
6. Sahebari M, Rezaieyazdi Z, Khodashahi M. Selenium and Autoimmune Diseases: A Review Article. *Curr Rheumatol Rev*. 2019;15(2):123-34. doi:10.2174/1573397114666181016112342
7. Türk İ, Cüzdan N, Çiftçi V, Arslan D, Doğan MC, Unal İ. Malnutrition, associated clinical factors, and depression in systemic sclerosis: a cross-sectional study. *Clin Rheumatol*. 2020;39(1):57-67. doi:10.1007/s10067-019-04598-y
8. van den Hoogen F, Khanna D, Fransen J, et al. Classification Criteria for Systemic Sclerosis: An ACR-EULAR Collaborative Initiative. *Arthritis Rheum*. 2013;65(11):2737-47. doi:10.1002/art.38098
9. Khanna D, Furst DE, Clements PJ, et al. Standardization of the modified Rodnan skin score for use in clinical trials of systemic sclerosis. *J Scleroderma Relat Disord*. 2017;2(1):11-18. doi:10.5301/jsrd.5000231
10. Alian SM, Eliwa EA kader, Ahmed SA, Ibrahim MIAEF. Cultural adaptation and validation of the scleroderma health assessment questionnaire into Arabic language. *Egypt Rheumatol Rehabil*. 2023;50(1):42. doi:10.1186/s43166-023-00209-6
11. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Blair SN, Church TS. Effects of Clinically Significant Weight Loss with Exercise Training on Insulin Resistance and Cardiometabolic Adaptations. *Obes Silver Spring Md*. 2016;24(4):812-19. doi:10.1002/oby.21404
12. Freedman LS, Commins JM, Moler JE, et al. Pooled results from 5 validation studies of dietary self-report instruments using recovery biomarkers for potassium and sodium intake. *Am J Epidemiol*. 2015;181(7):473-87. doi:10.1093/aje/kwu325
13. Dobrota R, Maurer B, Graf N, et al. Prediction of improvement in skin fibrosis in diffuse cutaneous systemic sclerosis: a EUSTAR analysis. *Ann Rheum Dis*. 2016;75(10):1743-48. doi:10.1136/annrheumdis-2015-208024
14. Mouthon L, Rannou F, Bérezné A, et al. Development and validation of a scale for mouth handicap in systemic sclerosis: the Mouth Handicap in Systemic Sclerosis scale. *Ann Rheum Dis*. 2007;66(12):1651-55. doi:10.1136/ard.2007.070532
15. Codullo V, Cereda E, Crepaldi G, et al. Disease-related malnutrition in systemic sclerosis: evidences and implications. *Clin Exp Rheumatol*. 2015;33(4 Suppl 91):S190-94.
16. Preis E, Franz K, Siegert E, et al. The impact of malnutrition on quality of life in patients with systemic sclerosis. *Eur J Clin Nutr*. 2018;72(4):504-10. doi:10.1038/s41430-018-0116-z
17. Caimmi C, Caramaschi P, Venturini A, et al. Malnutrition and sarcopenia in a large cohort of patients with systemic sclerosis. *Clin Rheumatol*. 2018;37(4):987-97. doi:10.1007/s10067-017-3932-y
18. Türk İ, Cüzdan N, Çiftçi V, Arslan D, Doğan MC, Unal İ. Malnutrition, associated clinical factors, and depression in systemic sclerosis: a cross-sectional study. *Clin Rheumatol*. 2020;39(1):57-67. doi:10.1007/s10067-019-04598-y
19. Baron M, Hudson M, Steele R, Canadian Scleroderma Research Group. Malnutrition is common in systemic sclerosis: results from the Canadian scleroderma research group database. *J Rheumatol*. 2009;36(12):2737-43. doi:10.3899/jrheum.090694
20. Preis E, Franz K, Siegert E, et al. The impact of malnutrition on quality of life in patients with systemic sclerosis. *Eur J Clin Nutr*. 2018;72(4):504-10. doi:10.1038/s41430-018-0116-z
21. Caimmi C, Caramaschi P, Venturini A, et al. Malnutrition and sarcopenia in a large cohort of patients

with systemic sclerosis. *Clin Rheumatol*. 2018;37(4):987-97. doi:10.1007/s10067-017-3932-y
22. Oreska S, Tomcik M, Oreska S, Tomcik M. *Gastrointestinal Involvement in Systemic Sclerosis: Overview, Neglected Aspects, Malnutrition, Body Composition and Management*. IntechOpen; 2019. doi:10.5772/intechopen.88286
23. Wojteczek A, Dardzińska JA, Małgorzewicz S, Gruszecka A, Zdrojewski Z. Prevalence of malnutrition in systemic sclerosis patients assessed by different diagnostic tools. *Clin Rheumatol*. 2020;39(1):227-32. doi:10.1007/s10067-019-04810-z
24. Harrison E, Herrick AL, McLaughlin JT, Lal S. Malnutrition in systemic sclerosis. *Rheumatology*. 2012;51(10):1747-56. doi:10.1093/rheumatology/kes160
25. Läubli J, Dobrota R, Maurer B, et al. Impaired micronutrients and prealbumin in patients with established and very early systemic sclerosis. *Clin Exp Rheumatol*. 2020;38 Suppl 125(3):120-26.
26. Nguyen AD, McMahan ZH, Volkmann ER. Micronutrient Deficiencies in Systemic Sclerosis: A Scoping Review. *Open Access Rheumatol Res Rev*. 2022;14:309-27. doi:10.2147/OARRR.S354736
27. Crincoli V, Fatone L, Fanelli M, et al. Orofacial Manifestations and Temporomandibular Disorders of Systemic Scleroderma: An Observational Study. *Int J Mol Sci*. 2016;17(7):1189. doi:10.3390/ijms17071189
28. Delano MJ, Moldawer LL. The origins of cachexia in acute and chronic inflammatory diseases. *Nutr Clin Pract Off Publ Am Soc Parenter Enter Nutr*. 2006;21(1):68-81. doi:10.1177/011542650602100168

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