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Nutritional Assessment of Hip and Neck of Femur Fractures among Elderly Patients in Qatar

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Abbreviations and Acronyms
Triceps Skin Fold thickness (TSF), Mid Upper Arm Circumference (MUAC), Mid Upper Arm Muscle Circumference (MUAMC), Geriatric Nutrition Risk Index (GNRI). Nutrition Risk Score – 2002 (NRS- 2002)

Abstract:
Introduction: Femoral neck fractures is one of the most common traumatic injuries in elderly and increasing continuously worldwide. The study aims to assess malnutrition among elderly admitted with hip and femur fracture in Qatar using different variables before and after surgery.
Materials and methods: Cross sectional study of 93 patients (42 males, 51 females) with femur fracture (elderly over 65 years) admitted to Hamad General Hospital HGH for surgery within the study period. Malnutrition assessed using, Anthropometric measurements, Biochemical laboratory values before and after surgery. Food intake measured through tray percentage consumption of lunch tray and Geriatric Nutrition Risk Index (GNRI) calculated from variables collected.
Results: Using GNRI 26.44% of patients were malnourished and increased to 46.91% after surgery. All variables decreased with age; females have higher anthropometric values than males, but significant difference only found for MUAMC (p value <0.05). Widowed females and married males have more tendency for femur fracture/malnutrition. Biochemical laboratory values decreased significantly after surgery except lymphocyte count. Laboratory values strongly correlated with each other except lymph count, negative correlation between age and anthropometric measurements positive correlation between BMI and anthropometric measurements.
Conclusion: Laboratory values and food consumption were underestimated since blood transfer for some patients were not considered and those who did not eat were not included in calculation. All malnutrition assessment tools consider several variables to assess malnutrition the more variables assessed the better assessment tool.
Keywords: Malnutrition, femur fracture, elderly, anthropometric measurements.
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Introduction:

Femoral neck fractures are one of the most common traumatic injuries in elderly. Patients increase continuously among the ageing population worldwide [1, 2]. Patients with Femur and hip fracture are more likely to be malnourished at the time of fracture [3–6]. Incidence of malnutrition has been reported to be as high as 48% at the time of admission [7–9] according to type of malnutrition assessment tool. Femur and Hip fractures are reported to be more common in females and the elderly [10–12]. This female tendency was found to significantly increase with advancing age ($p < 0.0001$) [13]. This could perhaps be attributed to lower bone mass density (BMD) as well as of the age-related increase in the incidence of falls in women compared with men [14]. Study on femoral neck fractures in New England revealed that the incidence among white women aged 65-69 years was 2,2 per 1000 per year. This rate increased up to 31.8 per 1,000 per year at the age of 90-94 years, with white men aged 65-69 years, the rate was 0.9 and rising to 20.8 for the 90-94 age group [15]. Males were half as likely to sustain a hip fracture, but their mortality within a year of the procedure is almost twice the rate of women [16].

The nutritional intervention of malnutrition in orthopedic patients has a significant effect in preventing operative and postoperative complications. Careful multi-disciplinary pre-operative assessment of nutritional status using biochemical and anthropometric variables [13] and optimization for surgery has been shown to improve functional outcomes and mortality. Like outcome in terms of mortality and functional recovery. They also have a considerable hospital and rehabilitation length of stay. Early mobility is associated with better outcome [17], and the degree of mobility following discharge.

Assessment of malnutrition using anthropometric variables such as BMI, MUAMC, TSF thickness are inexpensive, non-invasive, and relatively correct way of identification of malnourished patients who are at risk for developing poor outcomes after surgery [7, 19, 21]. Hip fractures represent a major economic burden on the health care systems in the world. In the United States, adjusted first-year costs after surgery associated with hip fracture for patients aged 65 years or older represents a substantial economic burden in addition to being most

strongly associated with mortality and morbidity rates [18, 20] The mean total cost per patient After 1 and 2 years of follow-up, Rehabilitation was the main cost determinant, and accounted for 46 % of total costs. Primary hospital admission days accounted for 22 % of the total costs, index surgery for 11 %, and physical therapy for 7 %.

Objectives.

Primary:

- Measure prevalence of malnutrition indicators before and after surgery in femur fracture patients admitted to Hamad General Hospital

Secondary:

- Observe complications from malnutrition status after discharge.

Materials and Methods:

Cross sectional study of 93 (42 males, 51 females) patients with femur fracture (elderly over 65 years) admitted to Hamad General Hospital HGH for surgery within the study period (Data collection from 2020 till May 2022) were included. This study was conducted after ethical approval and review from ABHATH at Hamad Medical Corporate.

Inclusion criteria: all femur fracture patients (elderly over 65 years) admitted to HGH hospital for surgery within the study period are included whether they have chronic comorbidities or not.

Exclusion criteria: Major traumas, Motor vehicle accidents, secondary fractures, or fractures for patients less than 65 years.

Malnutrition was assessed using:

1. Anthropometric measurements (Weight, Height, BMI, Triceps Skin Fold thickness, Mid Upper Arm Circumference, and Mid Upper Arm Muscle Circumference).
2. Food intake: measured through tray percentage consumption (by measuring weight of tray before and after eating on lunch and calculate percentage of food weight consumed).
3. Biochemical assessment of nutritional related lab values (hemoglobin, Lymphocyte count, total proteins, albumin) before and after surgery.
4. GNRI calculated from variables collected.

After identifying the target patient, we will go to the patient at lunch and measure percent consumption from lunch meal tray, measure MUAC, TSF thickness, check: use walking aids, marital status, after obtaining approval from patient or family on provided Consent form. Other indicators were taken from Computer Information System (Cerner) such as weight, height, Hgb., Lymphocyte count, Total protein, and albumin levels.

MUAMC and GNRI were calculated according to known formula:

1. Anthropometric measurements:
   a) Weight, Height and BMI:
   Measurements of weight, height and BMI were not measured but taken from patient medical file in Computer Information System (Cerner) used at Hamad Medical Corporate, Since the patient is unable to stand on scale. Patients divided into three age groups (65-74y, 75-84y, and > 85y) for both males and females Table 1.
   b) Skin Fold Thickness, Mid Upper Arm Circumference, and Mid Upper Arm Muscle Circumference:
   SFT is a measure for fat mass that give information about fat energy source, SFT was measured by two researchers, male for male patients and female researcher for female patients, all measurements were taken from left hand of patient using (Lange skinfold caliper). MUAC calculated by measuring tape and subsequently MUAMC was calculated using results from SFT and MUAC. (MUAMC=MUAC-(π*SFT).
2. Food intake:

- Tray weight, dishes with different types and soup container weight were known, weight of whole tray was recorded before giving the lunch tray to the patient, then weighted again. The decrease in weight of the tray is food consumed. Weight of the tray minus weight of tray and utensils used is the food weight. Food consumed divided by food weight multiplied with 100 is percent food consumed.
- Food is provided between 11:00-11.30 AM after 45 hours the catering staff collect the tray if the patient is finished eating otherwise, they keep the tray two hours with the patient, if not eaten we come next day to measure weight again, if he did not eat for the next day, food consumption for this patient is not included. Usually food consumption is measured from the third day after surgery only once.

3. Biochemical assessment of nutritional related lab values (hemoglobin, lymphocyte count, total proteins, albumin) before and after surgery.

- Laboratory values for hemoglobin, lymphocyte count, total protein and albumin are taken from patient file

at Computer Information System (Cerner) used at Hamad Medical Corporate. Even with blood transfusion, values taken before and after surgery.

4. GNRI is used to assess nutritional risk in elderly.
    - It uses albumin and current weight as the following equation GNRI = [1.489*albumin (g/L)] +[41.7 *(weight/WLo)], WLo ideal weight, calculated from the Lorentz equations: for men: (Ht.—100)—[(H—150)/4]; for women: Ht.—100—[(Ht.—150)/2.5](Ht.: height). From these GNRI values, 4 grades of nutrition-related risk were generated, high risk (GNRI: <82), moderate risk (GNRI: 82 to <92), low risk (GNRI: 92 to ≤98), and no risk (GNRI: >98). It was first developed in 2005 [22]. All patients with GNRI ≤98 was considered malnourished. Paired T- test between Hemoglobin, lymph count auto, total proteins, albumin, and GNRI before and after surgery were performed.
5. Quality of life:
    - We included in this marital status, use aids for mobility, and number of health-related conditions. Assuming that married take better care than widowed and divorced, and that those who does not use aids for mobility have muscle mass better than those who use aids and thus better quality of life and finally number of health-related conditions without respect to type of disease, the lower the number the better quality of life.

Results:

1. Anthropometric measurements (Weight, Height, BMI, Triceps Skin Fold thickness, Mid Upper Arm Circumference, and Mid Upper Arm Muscle Circumference).
    - Even with small sample size results show decline of (weight height, BMI, Skin Fold Thickness, Mid Upper Arm Circumference, and Mid Upper Arm Muscle Circumference) with increasing age for both sexes Table (1).

Table (1): Anthropometric measurements Vs. Age

AGE GROUP 65 – 74			AGE GROUP 75 – 84			AGE GROUP 85 ABOVE		
	Male (17)	Female (22)		Male (16)	Female (22)		Male (9)	Female (7)
BODY MASS INDEX			**BODY MAS INDEX**			**BODY MASS INDEX**		
BMI Mean	29.97	31.63	BMI Mean	26.58	28.89	BMI Mean	26.12	28.49
BMI Std. Dev.	4.42	7.81	BMI Std. Dev.	5.14	6.31	BMI Std. Dev.	2.79	4.29
% BMI <22.5	0%	9.09%	% BMI <22.5	25.00%	13.64%	% BMI <22.5	11.11%	0%
% BMI 22.6 – 29.0	47.01%	22.72%	% BMI 22.6 – 29.0	43.75%	50.00%	% BMI 22.6 – 29.0	77.77%	71.43%
% BMI >29.1	52.94%	68.18%	% BMI >29.1	31.25%	36.36%	% BMI >29.1	11.11%	28.57%
WEIGHT			**WEIGHT**			**WEIGHT**		
Weight Mean	88.41	80.85	Weight Mean	77.00	71.32	Weight Mean	70.00	69.74
Weight Std. Dev.	15.83	20.66	Weight Std. Dev.	14.81	14.65	Weight Std. Dev.	8.85	16.50
HEIGHT			**HEIGHT**			**HEIGHT**		
Height Mean	1.72	1.60	Height Mean	1.70	1.58	Height Mean	1.64	1.55
Height Std. Dev.	0.08	0.05	Height Std. Dev.	0.084	0.080	Height Std. Dev.	0.06	0.10
MUAC			**MUAC**			**MUAC**		
MUAC Mean	31.82	33.0	MUAC Mean	28.19	30.24	MUAC Mean	25.44	27.57
MUAC Std. Dev.	5.11	5.42	MUAC Std. Dev.	4.18	3.62	MUAC Std. Dev.	2.55	4.86
TSF			**TSF**			**TSF**		
TSF Mean	1.65	1.71	TSF Mean	1.27	1.21	TSF Mean	1.03	1.36
TSF Std. Dev.	1.08	1.00	TSF Std. Dev.	0.64	0.33	TSF Std. Dev.	0.58	0.30
MAC			**MAC**			**MAC**		
MAC Mean	26.65	27.63	MAC Mean	24.20	26.44	MAC Mean	22.20	23.31
MAC Std. Dev.	3.03	4.46	MAC Std. Dev.	2.83	2.94	MAC Std. Dev.	1.33	4.41

Table 2: Differences between sexes

		Mean	Std. Deviation	Significance
AGE (years)	Male	77.93	7.636	0.559
	Female	77.04	6.968	
BMI	Male	27.8513	4.68733	0.110
	Female	29.8461	6.79483	
WEIGHT (kg)	Male	80.1190	15.75143	0.171
	Female	75.2127	18.08240	
% FOOD CONSUMPTION	Male	40.227	24.6681	0.775
	Female	38.568	25.4224	
MUAC (cm)	Male	29.07	4.921	0.055
	Female	31.08	4.956	
TSF (cm)	Male	1.371	0.8538	0.637
	Female	1.450	0.7360	
MUAMC (cm)	Male	24.7651	3.14613	*0.024
	Female	26.5270	4.05416	
Hgb BEFORE SURGERY (gm/dL)	Male	11.890	2.4389	0.264
	Female	11.396	1.8016	
LYMPH COUNT_BEFORE SURGERY (10^3/uL)	Male	1.756	1.6947	0.604
	Female	1.618	0.7278	
TOTAL PROTEINS_BEFORE SURGERY (gm/L)	Male	67.83	8.621	0.752
	Female	67.24	7.779	
ALBUMIN_BEFORE SURGERY (gm/L)	Male	30.97	5.465	0.981
	Female	31.00	4.856	
Hgb AFTER SURGERY (gm/dL)	Male	10.636	2.0808	**0.004
	Female	9.460	1.7121	
LYMPH COUNT_AFTER SURGERY (10^3/uL)	Male	1.367	0.6983	0.432
	Female	1.509	0.9584	
TOTAL PROTEINS_AFTER SURGERY (gm/L)	Male	60.15	7.592	0.173
	Female	56.92	11.515	
ALBUMIN_AFTER SURGERY (gm/L)	Male	26.46	4.908	0.516
	Female	25.70	5.403	
GNRI	Male	108.5467	22.77210	0.781
	Female	106.7634	35.88777	

Females have greater values than males, but only significant with MUAMC (P-value <0.05).

2. Food intake:

   Patients who did not eat from their lunch for two days were excluded from calculations which increased the food intake percentage, even so the mean percentage for food intake was 39.3% (25.0 ± Standard Deviation). This percentage represent moderate malnutrition indicator according to Nutrition Risk Score – 2002.

3. Biochemical assessment of nutritional related lab values (hemoglobin, hematocrit, total proteins, albumin) before and after surgery.
   a. Albumin:

   30 male patients from 38 patient had Albumin level below 35 gm/L this constitute 78.95% from male patients while 41 female patients from 49 female patient had albumin level below 35 gm/L which represent 83.67%. After surgery 36 male patient from 37 male patients (97.30%) had albumin level below 35 gm/L and 42 female patients from 44 females had albumin level below 35 gm/L (95.45%). (Mean and standard deviation for albumin before surgery was (30.99 gm/L ± 5.1) this falls under low malnutrition grade depending on albumin

level, while it dropped after surgery to (26.05 gm/L± 5.17) which falls under moderate malnutrition.

b. Lymph count:
10 male patients from 41 patient had Lymph count level below 1.0 this constitute 24.39% from male patients while 13 female patients from 50 female patient had Lymph count level below 1.0 which represent 26.0%. After surgery 16 patient from 42 male patients (38.10%) had lymph count below 1.0 and 12 female patients from 47 females had lymph count below 35 (25.53%). (Mean and standard deviation for lymph count before surgery was (1.68 ± 1.25), while it dropped after surgery to (1.44 ± 0.844) this was not significant difference between before and after surgery for this variable.

c. Total protein:
15 male patients from 35 patient had total protein below 66 (42.86%). while 9 female patients from 45 female patient had total protein below 60 which represent 20.0%. After surgery 24 patient from 33 male patients (72.73%) had total protein below 66 and 27 female patients from 39 females had total protein below 60 (69.23%). (Mean and standard deviation for total protein before surgery was (67.50 ± 8.11), while it dropped after surgery to (58.40 ± 9.98) which is graded as malnutrition.

d. Hemoglobin:
28 male patients from 42 patient had hemoglobin below 13 gm/dL (66.67%). while 31female patients from 51 female patient had hemoglobin below 12 gm/dL which represent (61.78%). After surgery 35 patient from 42male patients (83.33%) had hemoglobin below 13 gm/dL and 45 female patients from 48 females had hemoglobin below 12 gm/dL (93.75%). (Mean and standard deviation for hemoglobin before surgery was (11.62 gm/dL ± 2.12), while it dropped after surgery to (10.01 gm/dL± 1.97) which is graded as malnutrition for both sexes.

4. GNRI:
(Mean ± SD) were (111.21±27.95), before doing the surgery and decreased to (101.13±15.91) after doing the surgery. 23 patients were ≤98 from the study population which represent 26.44% (number 87patients) and after surgery they increased to 38 patients, who constitute 46.91% (number 81patients) from patients at risk of malnutrition. No significant difference between males and females before and after surgery, for all paired tests. Results shown in table (3).

Paired sample tests for significance between Hemoglobin, lymph count, total proteins, albumin, and GNRI before and after surgery were performed.
All these variables decreased significantly except for lymph count, it decreased but not significantly.

Table 3: Paired T- test, before and after surgery

		Mean	Std. Deviation	significance
Pair 1	Hgb. BEFORE SURGERY	11.621	2.1501	< 0.0001
	Hgb. AFTER SURGERY	10.009	1.9724	
Pair 2	LYMPH COUNT_BEFORE SURGERY	1.674	1.2727	0.108
	LYMPH COUNT_AFTER SURGERY	1.447	0.8481	
Pair 3	TOTAL PROTEINS_BEFORE SURGERY	66.75	8.104	<0.0001
	TOTAL PROTEINS_AFTER SURGERY	57.95	10.143	
Pair 4	ALBUMIN_BEFORE SURGERY	30.77	5.328	<0.0001
	ALBUMIN_AFTER SURGERY	26.10	5.147	
Pair 5	GNRI BEFORE SURGERY	111.36	27.95	0.001
	GNRI AFTER SURGERY	101.49	27.94	

Paired sample tests for significance between Hemoglobin, lymph count, total proteins, albumin, and GNRI before and after surgery were performed.
All these variables decreased significantly except for lymph count, it decreased but not significantly.

Quality of life:

1. **Marital status:**

Married patients from both males and females constitute 60.2% from patients with femur fracture, widowed females constitute 32.6% from patients. On the other hand, married males constitute 85.7 % from males. This may come to conclusion that widowed females and married males are more prone to femur fracture!

2. **Number of health-related conditions:**

It is clear from table below that increased number of health-related issues are common among femur fractur patients. Patients who have more than three health related conditions constitute 46.24% from patients with femur fracture.

3. **Use of aids for mobility:**

Aids for mobility could be a Cane, wheelchair or use help from others. 43.01% from patients were using aids for mobility. Results seen in table (4).

Table 4: Quality of life.

Quality of life		
Marital status.		
- Married	Male – 36	Female – 20
- Widowed	Male – 5	Female – 30
- Divorced	Male – 1	Female – 0
Number of health-related conditions		
One health related condition	Male – 5	Female – 7
Two health related condition	Male – 8	Female – 13
Three health related conditions	Male – 13	Female – 4
3+ health related conditions	Male – 16	Female – 27
Aids for mobility		
Use aids males and females	Male – 18	Female – 22

Conclusion:

Malnutrition is an independent risk factor that negatively influence elderly patients. Early detection of malnutrition helps medical team to provide better medical care and better nutritional intervention that is designed to improve patient nutritional condition, clinical outcomes, and health cost. Malnutrition combined with femur fracture and surgery undergo high catabolic state leading to muscle wasting, post-operative complications, poor clinical outcomes, and increased mortality [17, 23, 24].

Routine nutrition screening for patients admitted to hospitals to detect patients at risk of malnutrition is practiced with different rates, maybe highest in United Kingdom (93%) [25]. 33 different Nutritional Risk scores are available [26]. All nutrition screening tools, or assessment tools use a cluster of variables such as age, weight loss, food intake, BMI, metabolic stress, disease severity, mobility, muscle mass, hand grip, and fat mass.

In our study we used individual variables of anthropometric measurements (SFT, MUAC, MUAMC and BMI), laboratory values (Hgb, lymph count, total protein, and albumin), food intake, and Quality of life (number of health conditions, use of aids for mobility, marital status). GNRI calculated from variables collected.

All anthropometric measurements decreased with age. Decline of weight height, BMI, Skin Fold Thickness, Mid Upper Arm Circumference, and Mid Upper Arm Muscle Circumference with increasing age for both sexes. Males have lower BMI than females, this could be explained as they are suffering from underweight more than females This was reported in [27,28]. They also found that females had larger SFT and MUAC but smaller MUAMC. In our research we found higher values for females in SFT, MUAC, and MUAMC measurements.

Aging increases fat mass and decreases muscle mass in both men and women [29]. Muscle mass has been taking a lot of concern lately and was included in many Nutritional assessment Tools in one way or another (hand grip strength, MUAMC, mobility, fat free mass, …) lastly in GlIM (Global Leadership Initiative on Malnutrition). [30] as main component with BMI, food intake, appetite, and biochemistry laboratory values.

Food intake:

Poor appetite and food intake are correlated with mortality [31] It is an independent risk factor for mortality and severity of disease [32]. Weight change is directly correlated with food intake [33]. Food intake at lunch was used to assess daily food intake [32]. Lunch is the best favored meal in the day at the Gulf region. Food intake is included in nutritional screening and assessment tools. Patients who did not eat for two days were not included in calculations, this may increase food intake for the elderly, but even with this food intake was only 39%, no significant difference was found between males and females.

Albumin is affected by dehydration, infection, inflammation, trauma, heart failure, liver dysfunction, hepatitis, renal failure, edema, and nephrotic syndrome. It has a long half-life, but it is

usually widely used [34, 35]. And usually incorporated in other nutrition assessment and screening tools.

Correlations:

- Prevalence of anemia is common in elderly. Hemoglobin was strongly correlated with total protein and albumin (P-value <0.01); this is stated in other researches which stated that there is high association between hemoglobin and other biochemical indicators of malnutrition [36].
- There was no correlation with lymph count since total lymphocyte count is usually affected by sepsis, hematologic disease, immune suppression and use of steroids. Some found that there is no correlation between lymphocyte count and nutritional status in elderly [37]. Lymph count before surgery was only correlated with TSF thickness (P-value <0.05). After surgery it was correlated with TSF thickness (P-value <0.05) and total protein (P-value <0.01).
- Age is negatively correlated with all variables but only significant for BMI (P-value <0.05), MUAC, TSF, MUAMC, GNRI (P-value <0.01).
- Negatively significant correlation between GNRI and Age (P-value <0.05), Total protein (P-value <0.01), Positive correlation with BMI, MUAC, MUAMC (P-value <0.01), TSF thickness and albumin (P-value <0.05). (table 5).
- Positive correlation between BMI with MUAC, MUAMC then TSF (P-value <0.01). Same results found also in (38).

- No significant correlation of food intake with any variable collected. Correlation seen in table 5.

Discussion:

All persons in this research are clinical dietitians, it was proposed to check food intake, but since no control over food entry to patients from outside the hospital, and assessing food intake using one meal, it was not properly assessed. Full day calculation for all meals would be better in assessing food intake as a risk factor for malnutrition. Food intake calculated was over estimated since we removed all patients who did not consumed food for two days from calculations. All biochemical lab values were overestimated since blood transfer for some patients was not considered.

Using one variable to assess malnutrition is not enough, otherwise we can say that 79% from elderly patients admitted with femur fracture are malnourished and 96% from elderly patients with femur fracture are malnourished after surgery based one albumin level.

All malnutrition assessment tools consider several variables to assess malnutrition the more variables assessed the better assessment tool. Since the age group (elderly) and the main health problem for admission is femur fracture we give 10% for ten variables measured (BMI≤ 22.5, MUAC ≤ 27, TSF ≤1.0, MUAMC ≤ 23.2 (25 percentile), Food consumption < 50%, Albumin <35 (gm/L), Lymphocyte count ≤ 1.0, Hemoglobin < 13 (gm/dL) for males, <12 (gm/dL) for females, total protein ≤60 and using of aids for mobility). Malnutrition percentage before surgery was 45.71% for males and 40.78% for females, For Both it was 43.01%. This means that they are admitted with malnutrition, more in males even if percentage of fractur is more in women, it is this attributed to osteoporosis or malnutrition? Further investigation should be provided.

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Conflicts of Interest

I have no conflict of interest to declare.

Table 5: correlations, * Correlation is significant at the 0.05 level (2-tailed).

		Age	BMI	Food Consumption	MUAC	TSF	MAC	Hgb Before Surgery	Lymph Count before Surgery	Total Proteins before Surgery	Albumin before Surgery	Hgb after Surgery	Lymph Count after Surgery	Total Proteins after Surgery	Albumin after Surgery	GNRI before Surgery	GNRI after Surgery
Age	Pearson Correlation	1	-.277**	-0.087	-.465**	-.300**	-.423**	-0.104	-0.056	-0.191	-0.178	0.008	-0.178	-0.039	-0.078	-.277**	-.316**
BMI	Pearson Correlation		1	0.078	.756**	.509**	.674**	-0.002	0.058	0.092	-0.109	0.028	0.137	0.129	-0.009	.362**	.709**
Food Consumption	Pearson Correlation			1	0.044	0.010	0.052	0.024	0.062	0.140	-0.047	0.052	0.013	0.229	-0.153	-0.143	-0.014
MUAC	Pearson Correlation				1	.692**	.879**	0.053	0.137	0.073	0.017	-0.077	0.083	-0.020	-0.026	.369**	.563**
TSF	Pearson Correlation					1	.265*	-0.038	.243*	0.057	-0.099	-0.117	.217*	0.014	-0.156	0.174	.402**
MAC	Pearson Correlation						1	0.097	0.024	0.059	0.089	-0.026	-0.029	-0.036	0.076	.374**	.493**
Hgb before surgery	Pearson Correlation							1	0.101	.455**	.484**	.617**	0.144	0.049	0.193	.223*	.226*
Lymph count before surgery	Pearson Correlation								1	0.100	0.104	0.094	.301**	0.059	0.069	0.041	0.151
Total Proteins before surgery	Pearson Correlation									1	.668**	.435**	.350**	.524**	.358**	0.101	.290*
Albumin before surgery	Pearson Correlation										1	.297**	0.135	.321**	.652**	.220*	.261*
Hgb after surgery	Pearson Correlation											1	.290**	.258*	.268*	0.177	.291**
Lymph count after surgery	Pearson Correlation												1	.413**	0.161	0.007	0.212
Total protein after surgery	Pearson Correlation													1	.401**	-.439**	.318**
Albumin after surgery	Pearson Correlation														1	.253*	.485**
GNRI before surgery	Pearson Correlation															1	.483**
GNRI after surgery	Pearson Correlation																1

****Correlation is significant at the 0.01 level (2-tailed). Table 5.**

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