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Original article

Body composition and nutritional status in preoperative patients with refractory chronic constipation

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Summary. *Background/Aims:* Altered body composition and malnutrition have been reported in some chronic diseases. However, no studies have examined the body composition and nutritional status in patients with refractory chronic constipation. The present study aimed to assess these two aspects in preoperative patients with refractory chronic constipation. *Methods:* One hundred seven patients with refractory chronic constipation, aged 18 to 63 years, and 133 healthy age-matched controls were enrolled. Assessment of body composition and nutritional status included anthropometry, biological nutritional parameters, and bioelectrical impedance analysis. *Results:* Preoperative patients with refractory chronic constipation and healthy subjects did not differ according to age or sex. Muscle mass, fat mass, fat-free mass, percent of body fat, fat mass index, and fat-free mass index were lower in the refractory chronic constipation group than in the control group. Fat mass index and fat-free mass index correlated significantly with body mass index in both male and female patients with refractory chronic constipation. No correlations were found between biological nutritional parameters and fat mass index or fat-free mass index, except for fat-free mass index in men. Based on body mass index and albumin, prealbumin, and transferrin levels, malnutrition existed in 28.04%, 0%, 37.38%, and 16.82%, respectively, of refractory chronic constipation patients. *Conclusions:* Parameters of body composition were worse in refractory chronic constipation patients than healthy participants, and several patients experienced malnutrition to some extent. Abnormalities in fat mass index and fat-free mass index might predict the nutritional status of patients with refractory chronic constipation.

Key words: body composition, body mass index, chronic constipation, malnutrition

Introduction

Constipation is a frequent gastrointestinal symptom caused by scarce or hard to pass bowel movements. Its prevalence in the pediatric, elderly, and general populations in China between 1995 and 2014 was 18.8%, 18.1%, and 8.2%, respectively (1). In other countries, constipation rates in the general population rate are higher; for example, 17.1% in Europe and Oceania (2), 16.5% in Korea (3) and 19.4% in United States (4). In the United States, 3.2 million patients with constipation seek medical advice each year (5), resulting in a cost of $1912 to $7522 per patient per year of treatment (6). Constipation not only increases the medical cost burden, but also affects the patient's quality of life, causing both physical and mental damage (7).

Constipation can be divided into two categories: functional or idiopathic and organic (8). Most cases are functional; medical therapies for functional constipation (FC) include increased fiber intake; use of laxatives, prokinetic drugs, and probiotics; and biofeedback therapy. For intractable FC, also called refractory

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chronic constipation (RCC), surgery is indicated if conservative treatments have failed (9). Although the main goal of surgical intervention in RCC is quality of life improvement, early and late post-operative complications are inevitable, and altered body composition may influence the frequency of such complications.

Altered body composition and malnutrition contribute substantially to postoperative morbidity and mortality (10, 11). Body composition includes many components, such as muscle mass (MM), fat mass (FM), fat-free mass (FFM), and percent body fat (PBF). Many previous studies identified low FFM (12-14), high FM (15, 16), and sarcopenic obesity (14, 17) as potential risk factors for postoperative morbidities such as increased infection, anastomotic leakage, and abscess, as well as readmission, reoperation, prolonged hospital stay, and mortality (18). As has been long recognized, substantial preoperative weight loss (11, 19)and both a low and high body mass index (BMI) (19, 20) also contribute to poor prognosis in surgical patients.Therefore, early identification of poor nutritional status and altered body composition in preoperative RCC is important, as it allows for proper nutrition support, which is considered essential for improved better clinical outcomes.

Many recent clinical nutrition studies have focused on the body composition and nutritional status of patients awaiting kidney transplantation and patients with chronic diseases, such as cancer and obstructive pulmonary disease. However, there are no body compositions or nutritional status data for patients with RCC for whom surgery is indicated. To close this knowledge gap, we examined the patients in this preoperative group with bioelectrical impedance analysis (BIA).

Materials and Methods

Patients and healthy participants

Patients with chronic constipation at the Research Institute of General Surgery of Jinling Hospital (Jiangsu, China) between July 2013 and August 2014 were enrolled in this study according to the following criteria. The inclusion criteria included: (1) patients with Rome III criteria-confirmed RCC; (2) patients with a long constipation history (≥ 2 years) with severely impaired quality of life; (3) patients aged 18–65 years; and (4) patients who met the criteria for surgical treatment and were undergoing surgery voluntarily for the first time. The exclusion criteria included: (1) patients with organic constipation; (2) patients undergoing reoperation; (3) patients with combined heart, liver, or kidney dysfunction; and (4) patients who were pregnant. For comparative purposes, age-matched data from healthy individuals (controls) were obtained after obtaining their consents from a health examination population at Jinling Hospital. Written informed consent was received from both patients and healthy participants. Before the study started, ethical approval was obtained from the Ethical Committee of Jinling Hospital.

Clinical data and methods

The clinical data were obtained from the medical records. Patient data were collected before 24–72 hours before surgery and included sex, age, comorbidities (e.g., stercoral obstruction of the colon, congenital megacolon, acquired giant colon disease, intestinal polyps, and hemorrhoids) and constipation duration. All anthropometric measurements were performed by trained nurses and with participants wearing light clothes and no shoes. Weight to the nearest 0.1 kg and height to the nearest 0.1 cm were measured by using a platform scale and wall-mounted stadiometer, respectively. Several biological nutritional parameters were measured from fresh blood samples before surgery, including albumin (g/L), prealbumin (mg/L), and transferrin (g/L). Body composition was measured via BIA (InBody S10, Korea),which included MM (kg), FM (kg), FFM (kg), and PBF (%). All body composition measurements were taken by the same experienced researcher. This measurement was taken under fasting, resting, and emptying urine and excrement conditions. Participants were asked to lay in a supine position with no body parts touching 15 min prior to the measurements. The first set of electrodes was placed on the wrist and the root of the middle finger, and the second set was placed on the ankle and the second toe. Based on FM and FFM data, we calculated the fat mass index (FMI) and fat-free mass index (FFMI), which were defined as FM/height^2 (kg/m^2) and FFM/height^2 (kg/m^2), respectively.

Classification of nutritional status

BMI was calculated by dividing body weight by squared body height (m^2). According to the World Health Organization (WHO), BMI is classified as one of four types: underweight, BMI <18.5 kg/m^2; normal weight, BMI 18.5–25 kg/m^2; overweight, BMI 25–30 kg/m^2; and obese, BMI ≥ 30 kg/m^2 (21). Malnutrition was defined as follows: BMI <18.5 as proposed by the WHO (World Health Organization, 2000), serum albumin level <30 g/L, serum prealbumin level <200 mg/L or serum transferrin level <2 g/L.

Statistical analysis

Statistical analyses were performed with GraphPad Prism 5 and SPSS software, version 19.0. Results were expressed as means and standard deviations (SD) for continuous variables, and as number (%) for categorical variables. The body composition of RCC patients and healthy controls was compared using a one-sample t-test. Associations between biological nutritional parameters or BMI and body composition were evaluated using Pearson's correlation test. For all analyses, a P-value < 0.05 was considered to be statistically significant, and confidence intervals (CI) were calculated at the 95% level.

Results

Characteristics of the RCC patients and healthy participants

There were 189 preoperative patients with Rome III criteria-confirmed RCC at Jinling Hospital between July 2013 and August 2014. After excluding 55 patients who did not meet the criteria for surgical treatment or who were unwilling to undergo surgical intervention, 5 patients with combined heart, liver, or kidney dysfunction, and22 patients who were undergoing reoperation, ultimately, 107 patients were analyzed in this study, including 16 men and 91 women, with a mean age of 39.4 years. The control group consisted of 133 healthy participants (33 men and 100 women) of similar ages as the patient group. No significant differences were observed in terms of sex or age between the two groups (P<0.05). The characteristics of the patients and controls are summarized in Table 1.

Biological nutritional parameters of the RCC patients

Based on standard biological evaluations, most of the RCC patients had good nutritional status: mean plasma albumin, 42.5±2.74 g/L; prealbumin, 213.6±76.02 mg/L, and mean transferrin, 2.7±0.76 g/L. Most biological parameters were within normal ranges

Table 1. Data of the participants characteristics

	RCC patients (study group)	Healthy Subjects (control group)	P-value
	n=107; Mean (SD)	n=133; Mean (SD)	
Age (years)	39.4 (11.14)	41.3 (11.02)	0.185
Sex	—	—	0.060
Male	16	33	
Female	91	100	
Height	163.1 (7.07)	164.1 (6.66)	0.254
Constipation duration(years)	10.5(8.62)	—	—
Number of Comorbidity	39	—	—
Stercoral obstruction of colon	17	—	—
Hirschsprung's disease	3	—	—
Acquired giant colon disease	14	—	—
Intestinal polyp	3	—	—
Haemorrhoids	2	—	—

in preoperative patients with RCC. Overall biological results and those reported by sex are shown in Table 2.

Body composition

The overall results of the comparison of body composition between patients with RCC and healthy controls and those reported by sex are shown in Table 3.MM, FM, FFM, PBF, FMI, and FFMI were significantly lower in all patients and male patients than in their healthy counterparts($P<0.05$). FM, FMI, and PBF were significantly lower in female patients than in female controls ($P < 0.001$), whereas FFM and FFMI were higher, although not significantly so. There was no statistically difference in MM between the two female groups ($P> 0.05$).

In a Pearson's correlation analysis of patients with RCC (Tab. 4), no nutritional biological parameter was seen to be significantly correlated with body composition in men and women. BMI correlated with FMI and FFMI regardless of sex and in all subjects (patient and healthy subjects combined) (Fig. 1). Correlation coefficients were higher in female patients than in fe-

Table 2. Mean (SD) values of biological nutritional parameters in patients with RCC

Value	Normal value	Female (n=91)	Male (n=16)	Total (n=107)
Albumin (g/L)	> 30	42.6 (2.27)	42.1 (4.67)	42.5 (2.74)
Prealbumin (mg/L)	200-400	217.3 (72.47)	192.9 (93.74)	213.6 (76.02)
Transferrin (g/L)	2.0-4.0	2.7 (0.78)	2.6 (0.64)	2.7 (0.76)

Table 3. Mean (SD) values of body composition and nutritional parameters between two groups

	Female subjects			Male subjects			Total subjects		
	Study group (n=91)	Control group (n=100)	P	Study group (n=16)	Control group (n=33)	P P	Study group (n=107)	Control group (n=133)	P
MM (kg)	23.6 (3.49)	24.0 (4.32)	0.540	26.1 (4.59)	32.4 (4.61)	<0.001	23.9 (3.75)	26.0 (5.70)	0.001
FM (kg)	9.3 (5.47)	17.9 (5.21)	<0.001	3.7 (3.57)	20.5 (1.15)	<0.001	8.4 (5.59)	18.5 (5.68)	<0.001
FFM (kg)	41.8 (4.83)	40.9 (2.90)	0.145	43.7 (8.40)	56.1 (6.19)	<0.001	42.0 (5.50)	44.7 (7.66)	0.003
PBF(%)	17.1 (0.09)	30.8 (0.06)	<0.001	6.7 (0.56)	26.3 (0.05)	<0.001	0.16 (0.09)	0.29 (0.06)	<0.001
FMI (kg/m^2)	3.6 (2.06)	6.9 (2.06)	<0.001	1.3 (0.37)	6.9 (0.37)	<0.001	3.2 (2.14)	6.9 (2.08)	<0.001
FFMI (kg/m^2)	16.1 (1.98)	15.7 (1.08)	0.151	14.8 (3.33)	18.8 (1.52)	<0.001	15.8 (2.26)	16.5 (1.78)	0.018
BMI(kg/m^2)	20.3 (3.00)	22.8 (2.97)	<0.001	19.0 (3.06)	25.7 (3.10)	<0.001	20.1 (3.02)	23.53 (3.24)	*P*<0.001
Weight (kg)	52.8 (8.06)	58.8 (6.24)	<0.001	57.9 (6.64)	76.5 (10.91)	<0.001	53.5 (8.05)	63.2 (10.83)	*P*<0.001

Table 4. Predictive factors of body composition in patients with RCC

	Female				Male			
	FMI		FFMI		FMI		FFMI	
	r	*P*	r	*P*	r	*P*	r	*P*
Age	0.19	0.074	0.05	0.643	0.22	0.405	0.18	0.502
BMI	0.75	<0.001	0.35	0.001	0.53	0.034	0.54	0.032
Albumin	-0.02	0.871	0.13	0.218	0.19	0.478	0.12	0.665
Prealbumin	-0.19	0.069	-0.06	0.565	0.15	0.590	-0.17	0.531
Transferrin	-0.20	0.060	-0.12	0.262	0.18	0.503	-0.20	0.470

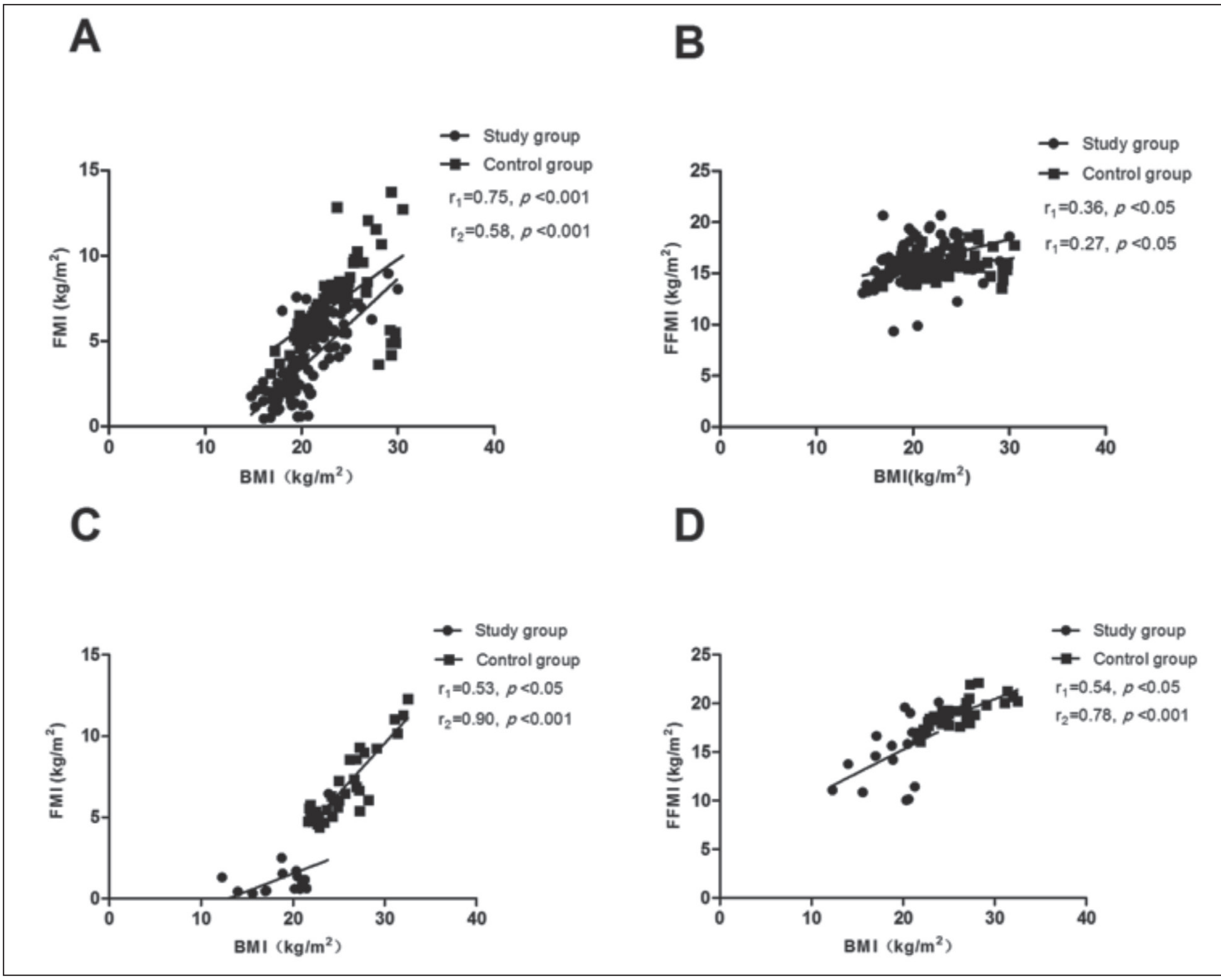

Figure 1. The relationship between BMI and FMI in women for total subjects; B: The relationship between BMI and FFMI in women for total subjects. C: The relationship between BMI and FMI in men for total subjects; D: The relationship between BMI and FFMI in men for total subjects; r1= the correlation coefficient of study group; r2=the correlation coefficient of control group.

male controls, but lower in male patients than in male controls (Fig. 1).

Nutritional status

The results of the comparison of nutritional parameters between patients with RCC and healthy controls are reported in Table 3. The BMI and weight of patients with RCC were significantly lower than the healthy control group. According to the WHO criteria, 30 patients with RCC were classified as underweight and only 4 as overweight (one of whom was obese) (Tab. 5). Although the mean BMI was in the healthy range (18.5–25) for most RCC patients (Tab. 1), 29.67% of female patients and 18.75% of the male patients had a BMI of ≤18.5. The percentages of malnourished patients based on BMI, albumin level, prealbumin level, and transferrin level were 28.04%, 0%,37.38%, and 16.82%, respectively.

Discussion

This study presents the first detailed data on body composition and nutritional status in patients with RCC in a hospitalized population. According to the European guidelines (21), most RCC patients in our study had good nutritional status. However, both male and female RCC patients had worse body composition

Table 5. Assessment of nutritional status in patients with RCC

	Female		Male		Total	
	n	%	n	%	n	%
BMI						
<18.5kg/m^2	27	29.67	3	18.75	30	28.04
18.5-25kg/m^2	60	65.93	13	81.25	73	68.22
25-30kg/m^2	3	3.30	-	-	3	2.80
>30kg/m^2	1	1.10	-	-	1	0.94
Albumin level ≤ 30 g/L	-	-	-	-	-	-
Prealbumin level ≤ 200 mg/L	28	30.77	12	75.00	40	37.38
Transferrin level < 2 g/L	15	16.48	3	18.75	18	16.82

parameters than did healthy control individuals. Both FMI and FFMI were lower in patients than in controls, most noticeably in men. Because both indices correlated with BMI regardless of sex or health status (RCC patients or healthy subjects), they may be predictive of nutritional status.

Numerous studies have reported that obesity affects constipation, but definitive evidence is scarce and most studies only included children. More obese children suffered from chronic FC than did normal-weight children in studies by Misra et al. (22)and Fishman et al. (23), and more children with FC were obese than were children without FC (22.4% versus 17.0%, n = 1649) in a study by Pashankar and Baucke (24). In contrast, in a clinical study by Aydoğduet al. (25), only 5.1% of 485 children with RCC were obese. Rather than the presence of constipation, a study of pediatric FC by Kavehmanesh et al. (8)significantly correlated obesity with the duration of constipation. Regarding adults, Vargas-Garcíaet al. (26) found that elderly Spanish patients with chronic constipation tended to be overweight, although not significantly so when compared with healthy subjects. Interestingly, in our study, only 3.7% (4/107) of patients were overweight (1 obese woman and 3 overweight women), and the BMIs of most of the other patients were within the normal range. Two explanations may account for the differences between our results and those noted above (22-24, 26). One, differences in patient characteristics may affect the relationship between obesity and constipation. Our study included patients with intractable chronic constipation and patients with a long constipation history (≥2 years) and no response to conservative treatment. Two, racial disparities in weight, height, and BMI may alter outcomes.

In our study, only 28.04% (30/107) of patients with RCC were malnourished (Tab. 5), and the mean BMI (68.2%, 73/107) of all patients was within the healthy range (18.5–25); however, the average levels of BMI and weight in patients with RCC were lower than in healthy subjects (Tab. 3). Based on prealbumin and transferrin levels, the percentages of malnourished patients were 37.38% and 16.82%, respectively. No patients suffered from malnutrition as defined by serum albumin levels; this may be because serum albumin is a relatively late marker of malnutrition. Although the patients with RCC had a good nutritional status in the present study, their body compositions were worse in comparison with the healthy control group. For example, MM, FM, FFM, PBF, FMI, and FFMI were significantly lower in all patients and male patients than their healthy counterparts (Tab. 3). A similar result was reported in a case control study conducted by Jeong-Soon You and his team: PBF was significantly lower in 52 patients with FC than in 52 patients without FC (27). A cross-sectional study performed by Jean-Pierre Gutzwilleret al. (28) demonstrated that constipation was an independent risk factor for malnutrition in hospitalized patients. BMI and body composition parameters should be considered as important markers of nutritional status, because they can better indicate either obesity or malnutrition than biochemical markers. These parameters are also associated with mortality and morbidity (29). It is unclear whether body composition correlates with preoperative nutritional risk or postoperative complications for surgical patients with RCC, and further prospective studies are needed.

BMI can be divided into FMI and FFMI, which implies that there is a significant relationship between BMI and FMI or FFMI. FM and FFM are important body composition parameters; however, there are no data as of yet regarding their relationship with BMI in patients with chronic constipation. In our study, there was a significant positive relationship between BMI and both FMI and FFMI in RCC patients independent of sex (Figure), in agreement with the results (study population were not RCC patients) of Moreau et al. (30) and Kyle et al. (31). Interestingly, these relationships also existed among all subjects when RCC patients and healthy participants were grouped together. Additionally, the correlation coefficient was higher in female patients than in female controls, although the opposite was observed in men. One reason for this difference may be sample size, which was smaller for men than women. Alternatively, the effects of age, height, and weight on FM and FFM may make it difficult to determine whether they are high or low (31). Because they are height-independent, so FMI and FFMI may be better indicators of nutritional status than FM and FFM (32). Moreover, previous studies suggest that high FMI correlates with functional disability and mortality (31) and low FFMI with increased length of hospital stay (33)and increased mortality (34, 35). Further research is necessary to evaluate the usefulness of FMI and FFMI as clinical prognostic markers in patients with RCC.

Several limitations of our study should be acknowledged. First, BIA is not a gold standard method for evaluating body composition, and data obtained via BIA combined with dual-energy x-ray absorptiometry may be more accurate than the data obtained via a single-method. Second, the number of patients included in the present study was relatively small, especially the number of men. Third, FM and FFM increase with age and we should have compared FMI and FFMI between across several age groups, but could not do so due to the small number of patients in all age groups, which did not allow statistical analysis.

In conclusion, the present study shows that body composition parameters are worse in RCC patients than in healthy participants and that some patients could be considered malnourished. FMI and FFMI were related to BMI in RCC patients independent of sex. Body composition and nutritional status in patients with RCC should be investigated in large prospective studies.Further, we also need to examine whether poor body composition or malnourished status in preoperative RCC patients is related to the postoperative outcomes.

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References

1. Chu H, Zhong L, Li H, Zhang X, Zhang J, Hou X. Epidemiology Characteristics of Constipation for General Population, Pediatric Population, and Elderly Population in China. Gastroenterol Res Pract. 2014;2014.
2. Peppas G, Alexiou VG, Mourtzoukou E, Falagas ME. Epidemiology of constipation in Europe and Oceania: a systematic review. BMC Gastroenterol.2008;8(6):5.
3. Jun DW, Park HY, Lee OY, Lee HL, Yoon BC, Choi HS,et al. A population-based study on bowel habits in a Korean community: prevalence of functional constipation and self-reported constipation. Dig Dis Sci. 2006;51(8):1471-77.
4. Johanson JF, Kralstein J. Chronic constipation: a survey of the patient perspective. Aliment PharmacolTher. 2007;25(5):599-608.
5. Peery AF, Dellon ES, Lund J, Crockett SD, McGowan CE, Bulsiewicz WJ, et al. Burden of gastrointestinal disease in the United States: 2012 update. Gastroenterology. 2012;143(5):1179-87.
6. Nellesen D, Yee K, Chawla A, Lewis BE, Carson RT. A systematic review of the economic and humanistic burden of illness in irritable bowel syndrome and chronic constipation. J Manag Care Pharm. 2013;19(9):755-64.
7. Belsey J, Greenfield S, Candy D, Geraint M. Systematic review: impact of constipation on quality of life in adults and children. Aliment PharmacolTher. 2010;31(9):938-49.
8. Kavehmanesh Z, Saburi A, Maavaiyan A. Comparison of body mass index on children with functional constipation and healthy controls. J Family Med Prim Care. 2013;2(3):222-6.
9. Kumar A, Lokesh H, Ghoshal UC. Successful outcome of refractory chronic constipation by surgical treatment: a series of 34 patients. J NeurogastroenterolMotil. 2013;19(1):78-84.
10. Purcell SA, Elliott SA, Kroenke CH, Sawyer MB, Prado CM. Impact of Body Weight and Body Composition on Ovarian Cancer Prognosis. Curr Oncol Rep. 2016; 18(2):1-11.

11. Itoh S, Shirabe K, Matsumoto Y, Yoshiya S, Muto J, Harimoto N, et al. Effect of Body Composition on Outcomes after Hepatic Resection for Hepatocellular Carcinoma. Ann Surg Oncol. 2014; 21(9):3063-3068.
12. Hassen TA, Pearson S, Cowled PA, Fitridge RA. Preoperative Nutritional Status Predicts the Severity of the Systemic Inflammatory Response Syndrome (SIRS) Following Major Vascular Surgery. Eur J Vasc Endovasc Surg. 2007; 33(6):696-702.
13. van Venrooij LM, de Vos R, Zijlstra E, Borgmeijer-Hoelen MM, van Leeuwen PA, de Mol BA. The impact of low preoperative fat-free body mass on infections and length of stay after cardiac surgery: a prospective cohort study. J Thorac-Cardiovasc Surg. 2011;142(5):1263-69.
14. Ida S, Watanabe M, Karashima R, Imamura Y, Ishimoto T, Baba Y, et al. Changes in body composition secondary to neoadjuvant chemotherapy for advanced esophageal cancer are related to the occurrence of postoperative complications after esophagectomy. Ann Surg Oncol. 2014; 21(11):1-5.
15. Shimizu A, Tani M, Kawai M, Hirono S, Miyazawa M, Uchiyama K, et al. Influence of visceral obesity for postoperative pulmonary complications after pancreaticoduodenectomy. J Gastrointest Surg. 2011;15(8):1401-10.
16. Waisbren E, Rosen H, Bader AM, Lipsitz SR, Rogers SO Jr, Eriksson E. Percent body fat and prediction of surgical site infection. J Am Coll Surg. 2010;210(4):381-9.
17. Visser M, van Venrooij LM, Vulperhorst L, de Vos R, Wisselink W, van Leeuwen PA, et al. Sarcopenic obesity is associated with adverse clinical outcome after cardiac surgery. NutrMetabCardiovasc Dis. 2013;23(6):511-8.
18. Haverkort EB, Binnekade JM, de van der Schueren MA, Gouma DJ, de Haan RJ. Estimation of body composition depends on applied device in patients undergoing major abdominal surgery. NutrClinPract. 2015;30(2):249-56.
19. van Venrooij LM, de Vos R, Borgmeijer-Hoelen MM, Haaring C, de Mol BA. Preoperative unintended weight loss and low body mass index in relation to complications and length of stay after cardiac surgery.Am J ClinNutr. 2008;87(6):1656-61.
20. Fujitani K, Ajani JA, Crane CH, Feig BW, Pisters PW, Janjan N, et al. Impact of Induction Chemotherapy and Preoperative Chemoradiotherapy on Operative Morbidity and Mortality in Patients with Locoregional Adenocarcinoma of the Stomach or Gastroesophageal Junction. Ann Surg Oncol. 2007; 14(7):2010-7.
21. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253.
22. Misra S, Lee A, Gensel K. Chronic constipation in overweight children. JPEN J Parenter Enteral Nutr. 2006;30(2):81-4.
23. Fishman L, Lenders C, Fortunato C, Noonan C, Nurko S. Increased prevalence of constipation and fecal soiling in a population of obese children. J Pediatr. 2004;145(2):253-4.
24. Pashankar DS, Loening-Baucke V. Increased prevalence of obesity in children with functional constipation evaluated in an academic medical center. Pediatrics. 2005;116(3):377-80.
25. Aydogdu S, Cakir M, Yuksekkaya HA, Arikan C, Tümgör G, Baran M, et al. Chronic constipation in Turkish children: clinical findings and applicability of classification criteria. Turk J Pediatr. 2009;51(2):146-53.
26. Vargas-Garcia EJ, Vargas-Salado E. Food intake, nutritional status and physical activity between elderly with and without chronic constipation. A comparative study. Cir Cir. 2013;81(3):214-20.
27. You JS, Park JY, Chang KJ. A case-control study on the dietary taurine intake, nutrient status and life stress of functional constipation patients in Korean male college students. J Biomed Sci 2010;17(46):325-32.
28. Gutzwiller JP, Aschwanden J, Iff S, Leuenberger M, Perrig M, Stanga Z. Glucocorticoid treatment, immobility, and constipation are associated with nutritional risk. Eur J Nutr. 2011;50(8):665-71.
29. Malietzis G, Currie AC, Athanasiou T, Johns N, Anyamene N, Glynne-Jones R, et al. Influence of body composition profile on outcomes following colorectal cancer surgery. Br J Surg. 2016; 103(5):572–580.
30. Moreau K, Desseix A, Germain C, Barthe N, Bachelet T, Morel D, et al. Body composition in 98 patients awaiting kidney transplantation. Nutrition. 2014;30(2):186-91.
31. Kyle UG, Schutz Y, Dupertuis YM, Pichard C. Body composition interpretation.Contributions of the fat-free mass index and the body fat mass index.Nutrition. 2003;19(7-8):597-604.
32. VanItallie TB, Yang MU, Heymsfield SB, Funk RC, Boileau RA. Height-normalized indices of the body's fat-free mass and fat mass: potentially useful indicators of nutritional status. Am J Clin Nutr.1990;52(6):953-59.
33. Tsaousi G, Kokkota S, Papakostas P, Stavrou G, Doumaki E, Kotzampassi K. Body composition analysis for discrimination of prolonged hospital stay in colorectal cancer surgery patients. Eur J Cancer Care. 2016.
34. Graf CE, Karsegard VL, Spoerri A, Makhlouf AM, Ho S, Herrmann FR, et al. Body composition and all-cause mortality in subjects older than 65 y. Am J Clin Nutr. 2015; 101(4):760-7.
35. Vestbo J, Prescott E, Almdal T, Dahl M, Nordestgaard BG, Andersen T, et al. Body mass, fat-free body mass, and prognosis in patients with chronic obstructive pulmonary disease from a random population sample: findings from the Copenhagen City Heart Study. Am J RespirCrit Care Med. 2006; 173(1):79-83.

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