·Colerectal Cancer-related Research·

Relationship between body mass index and colon cancer

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[Abstract] **Background and Objective**: Obesity is associated with increased risk of colorectal cancer. Many studies showed that body mass index (BMI) is related to the incidence of colon cancer. This study was to explore the relationship between BMI and colon cancer in Chinese population and provide evidences for the prevention of colon cancer. **Methods**: Clinical data, including BMI, of 707 colon cancer patients and 709 healthy subjects were compared. **Results**: The mean BMI was significantly higher in colon cancer patients than in healthy subjects [(24.52±4.56) kg/m^2 vs. (23.75±3.14) kg/m^2, t=−3.72, P<0.001]. When stratified by sex and age, the BMI was always higher in colon cancer patients than in healthy subjects. Logistic regression analyses showed that BMI was an important risk factor of colon cancer (odds ratio=1.059, 95% confidence interval=1.029−1.090). **Conclusion**: The occurrence of colon cancer in Chinese population is related to BMI.

Key words: colon neoplasm, risk factor, body mass index

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Globally, the incidence of colorectal cancer is increasing, especially the colon cancer which increases rapidly.[1] The risk factors of colon cancer are concerns of medical workers. Obesity has been proven to be the critical factor in the carcinogenesis and development of colorectal cancer.[2-3] Body mass index (BMI) is an important index that evaluates the obesity degrees. Some studies showed that BMI was in close association with colon cancer in both male and female.[4] In an attempt to the association of BMI and colon carcinogenesis, we compared MBI of 707 cases of colon cancer patients with 709 healthy individuals. Results are presented as follows.

Subjects and methods

Study subjects. Case group: clinical data of colon cancer patients who underwent operation in our hospital from January, 2000 to December, 2005 were retrospectively reviewed. Inclusion criteria: 1. Patients initially diagnosed with colon cancer; 2. Ages were above 18. A total of 707 cases (408 males and 299 females) were included. The ages were from 19 to 86 (mean, 58).

Healthy control group: healthy subjects underwent cancer

screening program in our hospital from 2005 to 2006 were enrolled. Inclusion criteria: 1. Cancer was excluded with screening; 2. Ages were above 18; 3. Non-pregnant women. A total of 709 healthy subjects (383 males and 325 females) were included, and the ages were from 21 to 88 (mean, 60).

Methods. Investigating contents of the case group included age, gender, height, body weight on admission, weight loss, pathological diagnosis; and the healthy group included age, gender, height and body weight.

Obesity was determined with BMI. Formula of BMI=body weight/height^2 (kg/m^2). The body weight of the case group included body weight on admission and the weight loss caused by the disease, and height is measured on admission. Body weight and height of the healthy group were determined on physical examination.

Based on the obesity classification criteria of Asia population and BMI characteristics of Han population,[5] five categories were defined: emaciation (BMI<18.5), normal (18.5-22.9), overweight (23.0-24.9), grade I obesity (25.0-29.9), grade II obesity (≥ 30).

Statistical analysis. SPSS 12.0 software was used for statistical analysis. Data were expressed as frequency, mean and SD. Differences of BMI of the case and control groups were analyzed with χ^2 test. Multiple linear regression was used to determine whether BMI was significantly associated with colon cancer. Test was bilateral and significance was defined when P<0.05.

Results

Mean BMI of the case and control groups with various ages and genders. Mean BMI of colon cancer group was 24.52 ± 4.56 kg/m^2, while the control group was 23.75± 3.14 kg/m^2. The difference was significant (t=-3.72, P<0.0001). After stratified by ages and genders, the BMI of case group was higher than control group (Tab. 1 and 2).

Comparisons of BMI between case and control groups after stratification with ages and genders. All subjects were divided by BMI: <18.5 was emaciation, 18.5-22.9 was normal, 23.0-24.9 was overweight, 25.0-29.9 was grade I obesity and ≥ 30 was grade II obesity. χ^2 test was performed after stratification with gender and the results showed that in obese and extreme obese group, the number of males were larger than control group, while the number of female patients in extreme obese group was larger than control group (P<0.05, Tab. 3).

Subjects were stratified by the age of 60 and χ^2 test was performed. The results showed that the number of colon cancer patients (both male and female) who were obese or extreme obese and under the age of 60 was significantly larger than control groups (P<0.05), while there was no significant difference for those above age 60 (P>0.05, Tab. 4).

Logistic regression of BMI, age and gender for patients with colon cancer. Logistic regression showed that the increase of BMI was a risk factor of colon cancer (OR, 1.059; 95% CI: 1.029-1.090).

Table 1 Body mass index (BMI) of colon cancer patients and healthy subjects after age-strafication

Age	Colon cancer patients		Health subjects		*P* value
	Cases	BMI(kg/m^2)	Cases	BMI(kg/m^2)	
18–29	21	22.56±3.79	27	22.88±2.99	0.739
30–39	74	23.28±5.14	86	23.39±2.41	0.855
40–49	119	24.41±4.26	64	22.16±2.89	<0.001
50–59	165	25.32±4.53	151	24.01±2.90	0.003
60–69	215	24.57±3.89	214	23.99±3.02	0.084
70–79	95	24.99±5.42	155	24.10±3.71	0.127
≥80	18	22.30±5.58	12	24.54±3.87	0.209
Total	707	24.52±4.58	709	23.75±3.14	<0.001

All values are presented as mean ± SD of relevant groups.

Table 2 BMI of colon cancer patients and health subjects after sex-strafication

Gender	Colon cancer patients		Health subjects		*P* value
	Cases	BMI(kg/m^2)	Cases	BMI(kg/m^2)	
Male	408	24.61±4.56	384	23.77±3.01	0.002
Female	299	24.40±4.56	325	23.72±3.30	0.034
Total	707	24.52±4.58	709	23.75±3.14	<0.001

All values are presented as mean ± SD of relevant groups.

Table 3 Chi-square test of BMI of colon cancer patients and health subjects after sex-strafication

Gender	BMI	Colon cancer patients [cases (%)]	Health subjects [cases (%)]	χ^2	*P* value
Male	<18.5	13 (3.2)	11 (2.9)	9.034	0.06
	18.5–22.9	130(31.9)	138(35.9)		
	23.0–24.9	109(26.7)	112(29.2)		
	25.0–29.9	130(31.9)	114(29.7)		
	⩾30	26 (6.4)	9 (2.3)		
	Total	408	384		
Female	<18.5	14 (4.7)	22 (6.8)	20.799	<0.001
	18.5–22.9	118(39.5)	118(36.3)		
	23.0–24.9	54(18.1)	72(22.2)		
	25.0–29.9	81(27.1)	105(32.3)		
	⩾30	32(10.7)	8 (2.5)		
	Total	299	325		

Table 4 Chi-square test of BMI of colon cancer patients and health subjects after age- and sex-strafication

Age	Gender	BMI	Colon cancer patients [cases (%)]	Health subjects [cases (%)]	χ^2	*P* value
⩽60	Female	<18.5	6 (3.5)	15 (8.0)	9.28	0.001
		18.5–22.9	77(44.3)	71(38.0)		
		23.0–24.9	28(16.1)	39(20.9)		
		25.0–29.9	44(25.3)	59(31.6)		
		⩾30	19(10.9)	3 (1.6)		
		Total	174	187		
	Male	<18.5	4 (1.9)	2 (1.4)	12.07	0.017
		18.5–22.9	72(35.1)	62(44.0)		
		23.0–24.9	56(27.3)	47(33.3)		
		25.0–29.9	59(28.8)	29(20.6)		
		⩾30	14(6.8)	1 (0.7)		
		Total	205	141		
>60	Female	<18.5	8 (6.4)	7 (5.1)	5.21	0.267
		18.5–22.9	41(32.8)	47(34.1)		
		23.0–24.9	26 (20.8)	33(23.9)		
		25.0–29.9	37(29.6)	46(33.3)		
		⩾30	13(10.4)	5 (3.6)		
		Total	125	138		
	Male	<18.5	9 (4.4)	9 (3.7)	2.12	0.713
		18.5–22.9	58(28.4)	76(31.3)		
		23.0–24.9	53(26.0)	65(26.7)		
		25.0–29.9	71(34.8)	85(35.0)		
		⩾30	12 (5.9)	8 (3.3)		
		Total	203	243		

Discussions

The relationship of body weight and health has long been noticed. If there are plenty of food (excessive intake of fat and starch) and less physical activity, body may become obese.

Table 5 Logistic regression analysis for risk factors of colon cancer

Items	B	SE	P	OR	95% CI
BMI	0.057	0.015	<0.0001	1.059	1.029–1.090
Age	−0.010	0.004	0.012	0.990	0.983–0.998
Sex	−0.220	0.111	0.048	0.803	0.646–0.998
Constant	−1.443	0.447	0.001	0.236	

Obesity has proven to be associated with genesis and development of colon cancer.[2,3] Dietary plays an important role in the pathogenesis of colon cancer, and high-fat diet can increase the risk of colon cancer.[6] BMI is a measurable index that is closely associated with human body content.[7] BMI is an important risk factor of many cancers such as breast cancer,[8] gastric cardia adenocarcinoma.[9] But it is a protective factor of lung cancer.[10] Therefore, to determine the relationship between BMI and colon cancer is conducive to understand the pathogenesis of colon cancer. And education of dietary during cancer prevention campaign is mandatory.

Because the study population is Han population, we divided the 707 patients and 709 healthy subjects into five groups by BMI according to the Asia obesity classification system and BMI characteristics of Han people,[5] and the bias due to inappropriate grouping can be avoided. Through retrospective investigation of the 707 cases of colon cancer patients who underwent operation and 709 healthy subjects, we found that mean BMI of colon cancer patients was 24.52± 4.56 kg/m^2, while mean BMI of healthy subjects was 23.75 ± 3.14 kg/m^2. And the difference was statistically significant (t=-3.72, P<0.0001). The result of the study suggested that colon cancer patients had higher BMI than healthy subjects. Similar result was obtained in different gender groups and different gender subgroups of young group (⩽ 60 years). Then we performed Logistic regression with the colon cancer as dependent variable and the age, gender and BMI as independent variables. The results showed that BMI is a risk factor of colon cancer that is independent of age and gender. Therefore, we concluded that BMI is closely associated with colon cancer in Han population.

With the improvement of living standard, the dietary construction has changed, with more red meat and less fiber, resulting in more and more people with overweight or obesity. And the obesity associated tumors such as breast cancer, colon cancer is increasing. The body weight control can be the primary prevention of cancers. 11 The measurement of BMI is convenient and easy to perform in clinical practice.[5] With BMI measurement, we can screen population with high risk of colon cancer and instruct them to modify their dietary constitutions to prevent colon cancer. This is meaningful for the prevention colon cancer.

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