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ORIGINAL RESEARCH

Correlation Between Skeletal Muscle Mass and Different Pathological Types of Colorectal Polyp in Chinese Asymptomatic Population

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Background: Low relative muscle mass was identified to be related to ascending risk of pre-cancerous polyps (adenoma) in recent cohort study. Our study aimed to dig out the correlation between muscle mass and different pathological types of colorectal polyps in Chinese asymptomatic population.

Methods: In all, 5923 adults were included. The effects of low skeletal muscle mass index (SMI) on colorectal polyp occurrence, including different pathological types, and the effects modification of age and BMI were analyzed using univariate and multivariate logistic regression.

Results: Lower SMI was connected with the lower occurrence of colorectal polyp (OR: 0.810, 95% CI: 0.683~0.960, p=0.015). Considering different pathological types of colorectal polyps, lower SMI was associated with lower occurrence of inflammatory polyp (OR: 0.633, 95% CI: 0.434~0.898, p=0.013), rather than conventional adenoma and serrated polyp (all p>0.05). Besides, SMI was positively related to the occurrence of 2 pathological types of colorectal polyp in males: inflammatory polyp (OR: 1.237, 95% CI: 1.058~1.444, p=0.007) and serrated polyp (OR: 1.288, 95% CI: 1.143~1.456, p<0.001). The interaction effect of BMI and SMI on occurrence of inflammatory polyp after adjusting age and smoking status was significant (p=0.015). For individuals with low SMI (compared with the normal SMI group), the incidence of inflammatory polyp was reduced from 8.95% to 3.50% in the low BMI quartile (Q1) in the adjusted model (OR of 0.332, 95% CI: 0.005–0.061, p<0.001). It was noticeable for males rather than females that individuals with colorectal polyps had higher levels of SMI (p=0.003). In addition, individuals with inflammatory polyps as well as serrated polyps possessed higher levels of SMI in males (all p<0.05).

Conclusion: Generally, especially in Chinese asymptomatic males, low SMI kept independent effect on the presence of inflammatory polyp and serrated polyp, rather than conventional adenoma.

Keywords: SMI, colorectal inflammatory polyp, Chinese asymptomatic males, BMI, bioelectrical impedance analysis, colonoscopy

Introduction

Colorectal cancer (CRC) is the fifth most common malignancy and the second-leading cause of cancer-related mortality, with an estimated 1 million CRC new cases and 0.5 million CRC-related deaths occurring in 2020 worldwide.[1] The incidence and mortality rates of CRC have significantly increased since 2000 in China.[2] Most CRCs derive from pre-cancerous polyps, including conventional adenomas and serrated polyps.[3] Thus, colonoscopy screening and removal of polyps are effective strategies to reduce the CRC-related incidence and mortality.[4,5] Colonoscopy surveillance is recommended at specified intervals, relying on risk stratification.[6] A Chinese randomized controlled trial identified that risk-adapted screening might be more effective than traditional screening strategies.[7] Currently, risk-score systems use simple risk factors, such as age, sex, family history, smoking and drinking habits.[8–10] However, a great number of

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researchers have proposed that other risk factors might be associated with colorectal polyps, including body fatness, physical activity and daily diet.[11–13] Therefore, discovery of new risk factors could be helpful for modifying risk-score systems.

Sarcopenia, a geriatric disease characterized by the progressive loss of muscle mass and increased amount of visceral fat, despite maintaining a relatively stable body weight.[14] Several underlying mechanisms have been elucidated, including insulin resistance, alteration of hormonal status, chronic inflammatory reaction and redox imbalance.[15–17] Colorectal adenoma and sarcopenia may share similar pathological mechanisms.[18,19] Muscle tissue is the primary site, in which glucose disposed mediated by insulin, therefore low muscle mass could aggravate insulin resistance.[20] Insulin resistance might be a risk factor for the development of colorectal neoplasia.[21–23] A recent large cohort study has found that low relative muscle mass was concerned with ascending risk of occurrence of advanced adenoma and overall adenoma at follow-up colonoscopy.[24] However, there are few studies that have discussed the relationship between low muscle mass and other different pathological types of colorectal polyps up to now.

Our study intended to dig out the correlation between muscle mass and different pathological types of colorectal polyps in Chinese asymptomatic group.

Methods

Study Population

We conduct a cross-sectional study at the First Affiliated Hospital of Wenzhou Medical University between January 2017 and June 2018. The study enrolled the participants aged 18 years or older, who underwent bioelectrical impedance analysis (BIA) and colonoscopies. Twenty patients with histories of colorectal surgeries were excluded.

Data Collection

Baseline characteristics, involving age, sex, drinking and smoking habits, diseases history, were acquired by self-administered questionnaires. Men with alcohol consumptions >140 g per week or women with alcohol consumptions >70 g per week were regarded as heavy drinkers. Smoking status was divided into 2 categories: current smoker or ex-smoker (has been smoking for at least 6 months) and non-smoker. The anthropometric measurement, fasting blood and biochemical parameters were detected in the morning.

The appendicular skeletal muscle mass (ASM, kg) was measured using a BIA (InBody770; InBody Japan Inc., Tokyo, Japan). The skeletal muscle mass index (SMI) was calculated using ASM (kg)/height^2 to evaluate the skeletal muscle mass. According to diagnostic criteria of Asian Working Group for Sarcopenia (AWGS) 2019 Consensus,[25] males with SMI<7.0 kg/m^2 and females with SMI<5.7 kg/m^2 were regarded as having low muscle mass (low SMI).

The endoscopic characteristics of colorectal polyps were recorded and analyzed, including the number, size and pathological type. Advanced adenoma was defined as the presence of at least 1 of the following features: with size over 10 mm in diameter, tubulovillous or villous structure, and high-grade dysplasia. Advanced neoplasm was defined as the presence of colorectal cancer or advanced adenoma.

Statistical Analysis

Category variables were compared by Pearson $\chi 2$ tests and displayed as frequencies (percentages). The normal distribution of continuous variables was tested by Shapiro–Wilk test. Continuous variables not fitting the normal distribution were compared by Wilcox test and displayed as median (range), while continuous variables fitting the normal distribution were compared by *t* test. The correlation between two random variables was performed by Spearman correlation analyses. The effects of low SMI on colorectal polyp occurrence, including different pathological types, and the effects modification of age and BMI were evaluated using univariate and multivariate logistic regression analyses. Variables with $p<0.1$ in univariate analysis were involved in the subsequent multivariate analysis. SMI of individuals with or without colorectal polyp was compared by Kruskal–Wallis test.

All statistical analyses were carried on by R version 3.6.1 (https://www.r-project.org/). All analyses were two-tailed, with p value<0.05 considered significant.

Results

Baseline Characteristics Between Normal SMI and Low SMI Groups

In all, we included 5923 individuals, of which 3767 (63.60%) were males, and 851 (14.37%) were in low SMI group (Table 1). The median of SMI was 7.29 kg/m^2, with a range from 3.12 to 19.08 kg/m^2(Table 1). Two thousand one hundred and ninety individuals were diagnosed with colorectal polyps (Table 2), with the incidence rate of 36.97%. Among those, 12 individuals were diagnosed with high-grade dysplasia, and 7 individuals were diagnosed with CRCs. Main pathological types included conventional adenoma (N=1050), inflammatory polyp (N=332), serrated polyp (N=680) and mixed type (N=108).

There was no statistical difference between normal and low SMI groups regarding age, smoking status, and diabetes mellitus (shown in Table 1, all p>0.05). The low SMI group showed a lower percentage of males than the normal SMI group (Table 1, p<0.001). BMI levels were higher in the normal SMI group (Table 1, p<0.001). In the low SMI group, the proportions of heavy drinkers, hypertension, dyslipidemia and hyperuricemia were lower than the normal SMI groups (Table 1, all p<0.05).

In individuals with colorectal polyps, there were statistical differences between the four different pathological types of colorectal polyps referring to age, ASM, SMI, smoking status, hyperuricemia and polyp size (Table 2, all p<0.05).

Correlation Between SMI and Colorectal Polyp and Its Different Pathological Types

We used univariable and multivariable logistic regression analyses to examine the effect of low SMI on colorectal polyp and different pathological types, respectively (Table 3 and Supplementary Table 1). The univariable and multivariable analyses revealed that low SMI was correlated with the lower occurrence of colorectal polyp [odds ratio (OR): 0.810, 95% confidence interval (95% CI): 0.683~0.960, p=0.015]. Besides, considering different pathological types of colorectal polyps, low SMI was associated with lower occurrence of inflammatory polyp with OR of 0.633 (95% CI: 0.434~0.898) and p value of 0.013.

When SMI was included in the univariable and multivariable analyses as a continuous variable (Table 4, Supplementary Tables 2 and 3), it was identified that each unit of SMI increasing was associated with a 15.7% augment of the presence of colorectal polyp in males, with p value of 0.014. In addition, SMI was positively associated with the occurrence of 2 pathological types of colorectal polyp in males: inflammatory polyp (OR: 1.237, 95% CI: 1.058~1.444,

Table 1 Baseline Characteristics According to Skeletal Muscle Mass Hierarchy

Variables	Total (N=5923)	Normal SMI (N=5072)	Low SMI (N=851)	P Value
Age (years)	47(18~84)	47(18~84)	47(18~84)	0.377
Male (%)	3767(63.60)	3298(65.02)	469(55.11)	<0.001
BMI (kg/m2)	23.95(14.13~37.01)	24.44(15.85~37.01)	20.7(14.13~34.50)	<0.001
ASM (kg)	20.16(7.99~53.86)	20.94(11.34~53.86)	16.05(7.99~22.71)	<0.001
SMI (kg/m^2)	7.29(3.12~19.08)	7.49(5.70~19.08)	6.19(3.12~7.00)	<0.001
Current or ex-smoker (%)	1711(28.89)	1472(29.10)	239(28.22)	0.630
Heavy drinker (%)	857(14.47)	756(14.94)	101(11.92)	0.024
Hypertension (%)	1742(29.41)	1541(30.45)	201(23.73)	<0.001
Diabetes mellitus (%)	570(9.62)	495(9.77)	75(8.81)	0.418
Dyslipidemia (%)	3693(62.35)	3201(63.41)	492(57.88)	0.002
Hyperuricemia (%)	1377(23.25)	1265(25.08)	112(13.21)	<0.001

Note: Values are expressed as frequencies (percentages), or medians (ranges).
Abbreviations: ASM, appendicular skeletal muscle mass; SMI, skeletal muscle mass index; BMI, body mass index.

Table 2 Baseline Characteristics According to Different Pathological Type of Colorectal Polyps [Median (Range) or n (%)]

Variables	Total[&] (N=2190)	Conventional Adenomas (N=1050)	Inflammatory Polyp (N=332)	Serrated Polyp (N=680)	Mixed Type[#] (N=108)	p Value
Age (years)	50(21~84)	52(21~84)	49(21~76)	48(22~79)	51(28~73)	<0.001
Male (%)	1603(73.20)	761(72.48)	235(70.78)	521(76.62)	86(79.63)	0.065
BMI (kg/m^2)	24.54 (15.18~36.73)	24.48 (15.18~35.75)	24.25 (18.51~36.73)	24.59 (16.76~35.74)	25.44 (18.67~34.70)	0.061
ASM (kg)	21.00 (8.90~53.86)	20.71 (8.90~31.36)	21 (9.72~31.40)	21.49 (11.22~53.86)	22.08 (11.67~30.88)	0.001
SMI(kg/m^2)	7.50 (4.35~19.08)	7.44 (4.35~9.92)	7.46 (4.66~11.50)	7.63 (4.82~19.08)	7.67 (5.33~9.64)	0.004
Low skeletal muscle mass (%)	271(12.37)	139(13.24)	32(9.64)	92(13.53)	8(7.41)	0.101
Current or ex-smoker (%)	790(36.07)	332(31.74)	134(40.36)	278(40.88)	46(42.59)	<0.001
Heavy drinker (%)	400(18.26)	181(17.30)	57(17.17)	136(20.00)	26(24.07)	0.201
Hypertension (%)	779(35.57)	394(37.67)	121(36.45)	226(33.24)	38(35.19)	0.311
Diabetes mellitus (%)	303(13.84)	143(13.62)	47(14.16)	93(13.68)	20(18.52)	0.567
Dyslipidemia (%)	1423(64.98)	690(65.84)	205(62.50)	454(66.86)	74(69.16)	0.482
Hyperuricemia (%)	550(25.11)	239(22.89)	86(26.22)	191(28.09)	34(31.78)	0.038
Polyp size*≥1cm	136(6.21)	92(8.76)	13(3.92)	21(3.09)	10(9.26)	<0.001

Notes: andTable 2 included individuals with colorectal polyps, excluded individuals with colorectal cancer or high-grade intraepithelial neoplasia. #In individuals with multiple polyps, pathological type contained 2 or more types. *In individuals with multiple polyps, size was based on the largest polyp.

Table 3 Univariable and Multivariable Logistic Regression Analyses to Examine the Effect of Low Skeletal Muscle Mass* on Colorectal Polyps and Different Pathological Types

Event	Event/Total		Univariate Analysis		Multivariate Analysis	
	Normal SMI	Low SMI	Crude OR (95% CI)	*p* Value	Adjust OR (95% CI)	*p* Value
Colorectal polyp	2051/5072	291/851	0.765 (0.657~0.891)	<0.001	0.810 (0.683~0.960)	0.015
Conventional adenoma	1003/5054	146/849	0.839 (0.691~1.013)	0.071	0.836 (0.677~1.027)	0.092
Inflammatory polyp	348/5054	37/849	0.616 (0.429~0.860)	0.006	0.633 (0.434~0.898)	0.013
Serrated polyp	651/5054	96/849	0.862 (0.683~1.078)	0.202		
Advanced adenoma	151/5054	21/849	0.824 (0.504~1.277)	0.410		
Advanced neoplasm	155/5054	21/849	0.802 (0.491~1.242)	0.348		

Note: Take normal skeletal muscle mass group as the reference.

p=0.007) and serrated polyp (OR: 1.288, 95% CI: 1.143~1.456, p<0.001). However, there was no correlation found between SMI and colorectal polyp, and their different pathological types in females (all p>0.05).

Interaction of SMI, Age and BMI for Colorectal Polyp and Its Different Pathological Types in Male

By Spearman test, it was revealed that both age and BMI had correlation with SMI, which was displayed in Figure 1 and supplement Table 4.

Considering SMI was associated with the occurrence of inflammatory polyp and serrated polyp in males, we examined the interaction effect of SMI and age (or BMI) on inflammatory polyp and serrated polyp (Figure 2). The interaction effect of BMI and SMI on occurrence of inflammatory polyp after adjusting age and smoking status was significant (Figure 2, p=0.015).

Table 4 Univariable and Multivariable Logistic Regression Analyses to Examine the Effect of Skeletal Muscle Mass Index on Colorectal Polyps and Different Pathological Types

Event	Univariate Analysis		Multivariate Analysis	
	Crude OR (95% CI)	*p* Value	Adjust OR (95% CI)	*p* Value
Male				
Colorectal polyp	1.157(1.057~1.267)	0.002	1.157(1.031~1.302)	0.014
Conventional adenoma	0.983(0.882~1.092)	0.747		
Inflammatory polyp	1.202(1.026~1.399)	0.019	1.237(1.058~1.444)	0.007
Serrated polyp	1.270(1.128~1.433)	<0.001	1.288(1.143~1.456)	<0.001
Advanced adenoma	1.095(0.862~1.355)	0.434		
Advanced neoplasm	1.092(0.862~1.349)	0.444		
Female				
Colorectal polyp	1.103(0.942~1.293)	0.224		
Conventional adenoma	1.145(0.935~1.402)	0.191		
Inflammatory polyp	0.993(0.716~1.371)	0.966		
Serrated polyp	0.977(0.748~1.272)	0.861		
Advanced adenoma	0.863(0.514~1.437)	0.575		
Advanced neoplasm	0.858(0.514~1.421)	0.557		

Table 5 further quantifies the effect modification of BMI on efficacy of low SMI in occurrence of colorectal polyp in males, including inflammatory polyp or serrated polyp. For individuals with low SMI (compared with the normal SMI group), the incidence of inflammatory polyp was reduced from 8.95% to 3.50% in the low BMI quartile (Q1), with OR of 0.332 (95% CI: 0.005–0.061) and p value<0.001 in the adjusted model. However, in the high BMI quartiles (Q2 to Q4), the effect of SMI on inflammatory polyp was insignificant (OR: 1.028, 95% CI: 0.508–1.886, p=0.934). A test of interaction between BMI and SMI group on inflammatory polyp was statistically significant (p=0.018). For colorectal polyp (p=0.483) and serrated polyp (p=0.102), interaction between BMI and SMI group was not observed.

Different SMI in Individuals with and without Colorectal Polyps

As for males, it was noticeable that individuals with colorectal polyps had higher levels of SMI (p=0.003). Besides, it showed that the males with inflammatory polyps as well as serrated polyps possessed higher levels of SMI (Figure 3, all p<0.05). As for females, there was no significant association found between individuals with and without colorectal polyps and different pathological types (all p>0.05).

Discussion

In this large, cross-sectional research, we discovered a significant correlation between skeletal muscle mass and colorectal inflammatory polyp, in Chinese asymptomatic population. Besides, as an index to evaluate muscle mass, SMI was positively associated with incidence of colorectal polyp, especially inflammatory and serrated polyp, in Chinese males. Furthermore, distinct patterns between BMI Q1 and BMI Q2 to Q4 in terms of the association with colorectal inflammatory polyp and effect modification on low SMI efficacy were observed in this study. Taken together, our results indicated that among Chinese asymptomatic males with low BMI, the occurrence of colorectal inflammatory polyp was

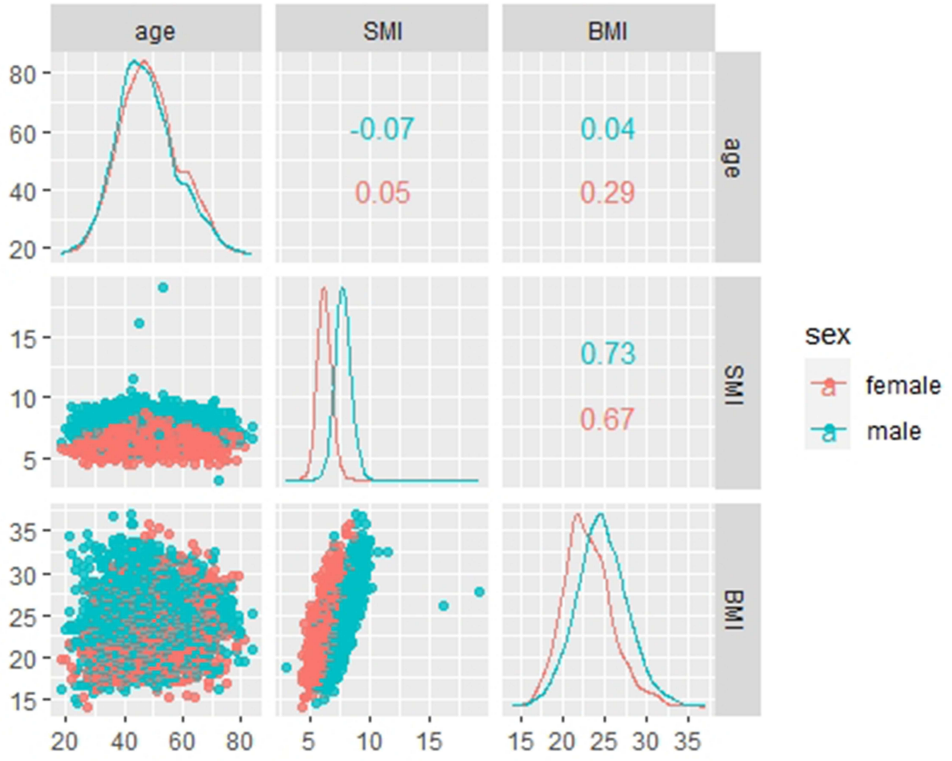

Figure 1 Matrix Scatter plots: association between SMI, Age and BMI.
Notes: Numbers in top-right corner of the 3 figures were correlation coefficients. The 3 figures in the diagonal line were density figures for age, SMI and BMI, respectively. The 3 figures in left-bottom corner were scatter figures.
Abbreviations: BMI, body mass index; SMI, skeletal muscle mass index.

reduced by low skeletal muscle mass. These findings could be helpful for targeting those who were at high risk of colorectal inflammatory polyp and who would be suited to maintain relatively low muscle mass.

Our study differed from previous studies containing an association between low skeletal muscle mass and prevalence of colorectal polyp. A number of researches had found that low skeletal muscle mass was associated with an increased prevalence of colorectal neoplasia.[26–28] Study by Ji Taek Hong et al proposed that sarcopenia was progressively associated with the risk of advanced colorectal neoplasm.[27] Yoon Suk Jung et al discovered that relative muscle mass was negatively associated with colorectal neoplasm prevalence.[26] Our study offered different results to evaluate the effect of skeletal muscle mass modified by BMI on colorectal inflammatory polyp. Colorectal inflammatory polyps, though generally benign, can be indicators of underlying chronic inflammation, such as inflammatory bowel disease,[29–31] which if left untreated, may lead to more serious complications such as malabsorption, or even the development of neoplastic changes over time.[29] Therefore, accurate identification and monitoring of inflammatory polyps through colonoscopy are crucial for early intervention and prevention of potential adverse outcomes. In addition, the presence of inflammatory polyps serves as a reminder of the need for comprehensive patient care, including lifestyle modifications, medical management of inflammatory bowel disease, and regular follow-up colonoscopies to monitor for changes in polyp size, number, or malignant transformation.

We do not know the exact mechanisms by which skeletal muscle mass index was positively associated with occurrence of colorectal inflammatory polyp. Previous studies about colorectal inflammatory polyp are very rare. A Chinese research mentioned that elevated fasting blood glucose was a protective factor for inflammatory polyp, while patients with fasting glucose≥6.5 mmol/L had a significantly lower risk of inflammatory polyps than those with <5.6 mmol/L.[32] Increased glucose is one of essential elements for metabolic syndrome; meanwhile, loss of muscle mass is closely linked to insulin resistance and metabolic syndrome.[33] It appears that metabolic syndrome containing increased

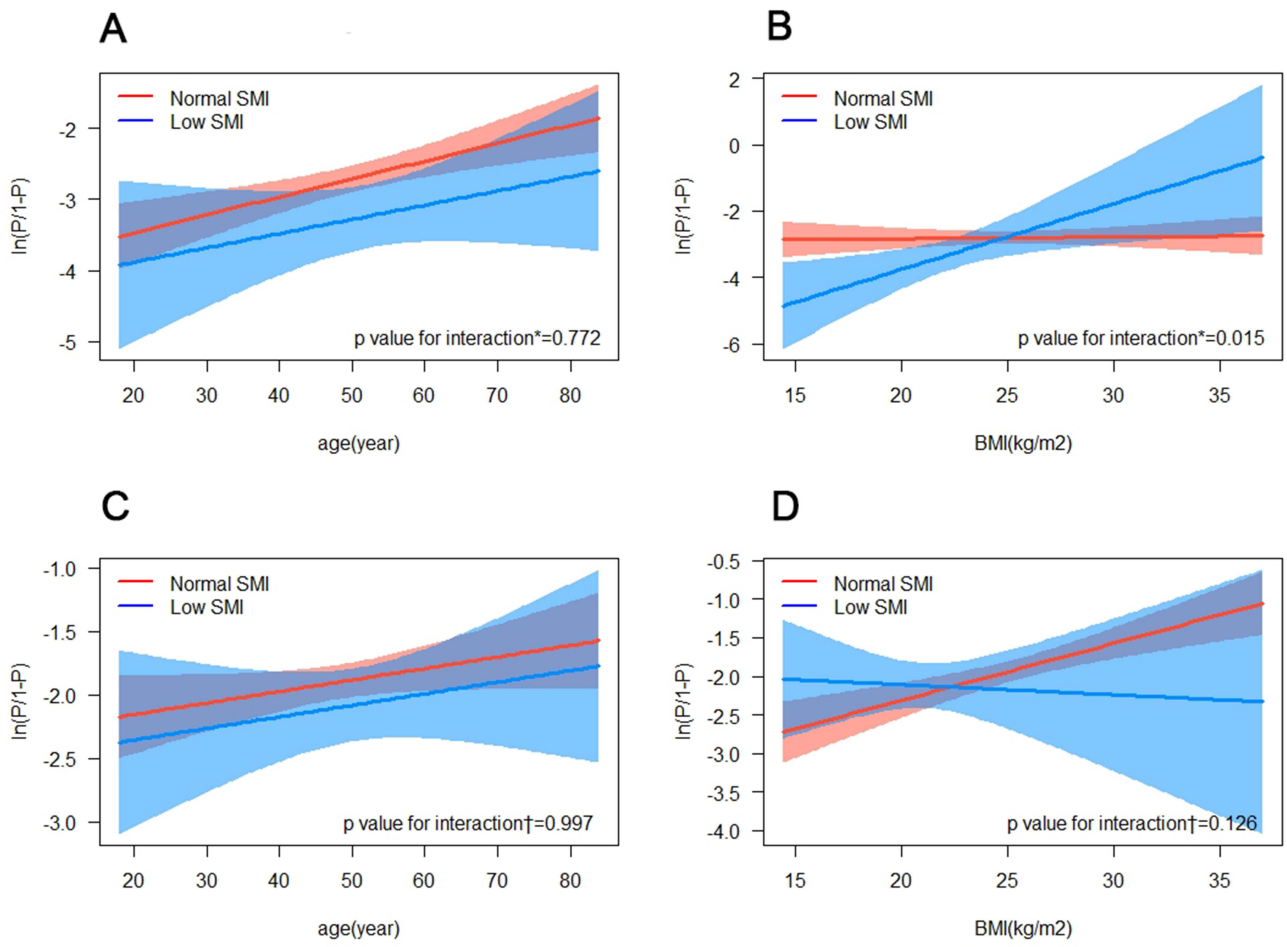

Figure 2 Effect modification of age or BMI on low SMI in occurrence of colorectal inflammatory polyp or serrated polyp in male. (**A**), effect modification of age on low SMI in occurrence of inflammatory polyp. (**B**), effect modification of BMI on low SMI in occurrence of inflammatory polyp. (**C**), effect modification of age on low SMI in occurrence of serrated polyp. (**D**), effect modification of BMI on low SMI in occurrence of serrated polyp.*, adjusted for age and smoking status. †, adjusted for age, smoking status and DM.

Abbreviations: P, prevalence; SMI, skeletal muscle mass index.

glucose may be an underlying mechanism for the association between colorectal inflammatory polyp and skeletal muscle mass. In addition, gut microbiota dysbiosis might play an important part. Previous experiment in animal models provided evidence that proportions of Porphyromonadaceae were significantly more abundant in colorectal inflammatory polyp-affected miniature dachshunds.[34] Also, elevated gut microbiome abundance of Porphyromonadaceae was identified to be associated with reduced visceral adipose tissue and healthier metabolic profile.[35,36] And decreased visceral adipose tissue and healthier metabolic surroundings were also related to more powerful skeletal muscle.[37,38] Thus, the presence of "skeletal muscle-gut axis" may explain the association between colorectal inflammatory polyp and muscle mass, whereby gut microbiota may act as mediators.[39–42]

This study also found that BMI played an important role in the association between colorectal inflammatory polyp and low muscle mass. As BMI decreased, the skeletal muscle mass also decreased.[43] As Table 1 in our study showed, there was a relatively low BMI in low muscle mass group ($p<0.001$). Moreover, it was well-known that BMI was positively associated with higher risk of colorectal polyp.[12,24,44–46] Thus, our results about correlation between muscle mass and colorectal polyps might be associated with BMI. Obesity, often measured by an elevated BMI, is recognized as a major public health concern due to its association with various chronic diseases, including colorectal cancer.[47,48] The link between obesity and colorectal polyps, including adenoma that can progress to malignancy if left untreated, has been

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Table 5 Effect Modification of BMI on Low Muscle Mass in Occurrence of Colorectal Polyps in Males

Event	Normal SMI		Low SMI		Crude		p value*for Interaction	Adjusted†		p Value*for Interaction
	Total	Event (%)	Total	Event (%)	OR (95% CI)	p value		OR (95% CI)	p Value	
Colorectal polyp										
BMI Q1 (<22.69kg/m^2)	594	230 (38.72)	344	134 (38.95)	1.010 (0.768–1.325)	0.944	Ref			
BMI Q2-Q4	2704	1302 (48.15)	122	64 (52.46)	1.188 (0.826–1.712)	0.352	0.483			
BMI Q2 (≥22.69-<24.59kg/m^2)	857	369 (43.06)	84	44 (52.38)	1.455 (0.928–2.286)	0.102				
BMI Q3 (≥24.59-<26.61kg/m^2)	915	433 (47.32)	26	13 (50.00)	1.113 (0.506–2.450)	0.788				
BMI Q4 (≥26.61kg/m^2)	932	500 (53.65)	12	7 (58.33)	1.210 (0.383–4.113)	0.747				
Inflammatory polyp										
BMI Q1 (<22.69kg/m^2)	592	53 (8.95)	343	12 (3.50)	0.369 (0.186–0.677)	0.002	Ref	0.332 (0.005–0.061)	<0.001	Ref
BMI Q2-Q4	2692	199 (7.39)	121	11 (9.09)	1.253 (0.627–2.265)	0.488	0.008	1.028 (0.508–1.886)	0.934	0.018
BMI Q2 (≥22.69-<24.59kg/m^2)	853	54 (6.33)	83	7 (8.43)	1.363 (0.550–2.914)	0.460		1.022 (0.398–2.275)	0.96	
BMI Q3 (≥24.59-<26.61kg/m^2)	911	65 (7.13)	26	4 (15.38)	2.366 (0.677–6.409)	0.123		1.926 (0.540–5.355)	0.251	
BMI Q4 (≥26.61kg/m^2)	928	80 (8.62)	12	0 (0.00)	NA	0.984		NA	0.983	
Serrated polyp										
BMI Q1 (<22.69kg/m^2)	592	68 (11.49)	343	48 (13.99)	1.254 (0.840–1.859)	0.263	Ref			
BMI Q2-Q4	2692	446 (16.57)	121	15 (12.40)	0.713 (0.395–1.197)	0.227	0.102			
BMI Q2 (≥22.69-<24.59kg/m^2)	853	118 (13.83)	83	10 (12.05)	0.853 (0.404–1.626)	0.652				
BMI Q3 (≥24.59-<26.61kg/m^2)	911	136 (14.93)	26	1 (3.85)	0.228 (0.013–1.089)	0.149				
BMI Q4 (≥26.61kg/m^2)	928	192 (20.69)	12	4 (33.33)	1.917 (0.507–6.152)	0.292				

Notes: p value for interaction test: 2-way interaction of BMI (Q2-Q4 vs Q1) and SMI group (low SMI vs normal SMI) on colorectal polyp occurrence, including inflammatory polyp and serrated polyp. †Adjusted for age, smoking status and DM.The normal SMI group is the reference group.

Abbreviations: CI, confidence interval; OR, odds ratio; Q, quartile; NA, not available.

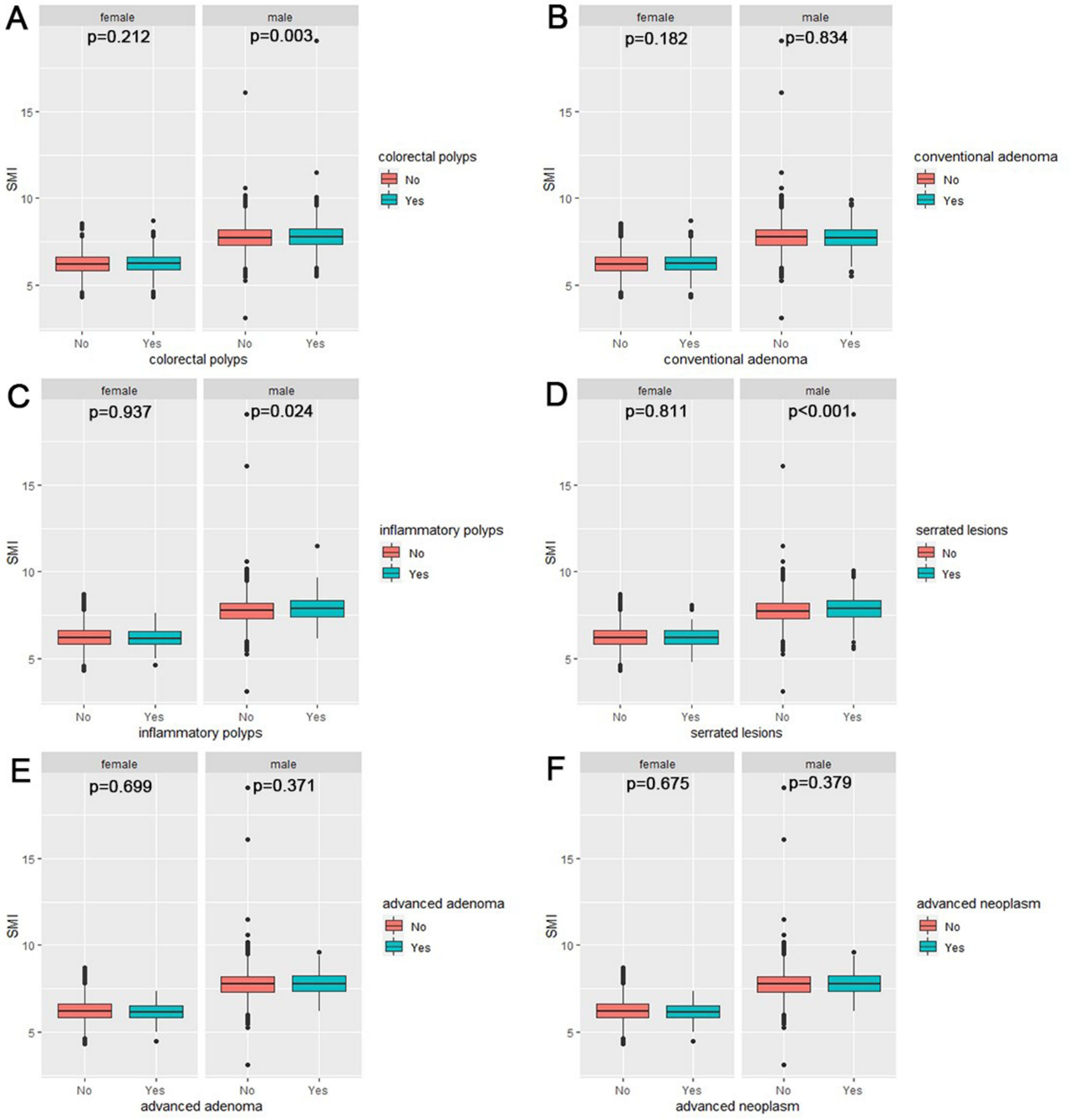

Figure 3 SMI of individuals with and without colorectal polyp or different pathological types were compared. (**A**), SMI of individuals with and without colorectal polyp; (**B**), SMI of individuals with and without conventional adenoma; (**C**), SMI of individuals with and without inflammatory polyp; (**D**), SMI of individuals with and without serrated polyp; (**E**), SMI of individuals with and without advanced adenoma; (**F**), SMI of individuals with and without advanced neoplasm.
Abbreviations: SMI, skeletal muscle mass index.

consistently observed in epidemiological studies.[49,50] Individuals with higher BMI have an increased risk of developing colorectal polyp, potentially due to chronic inflammation caused by imbalanced metabolism, distinct immune cells, cytokines, and other immune mediators.[48] However, the exact mechanism by which BMI may be influential in the association between SMI and colorectal inflammatory polyp was not fully understood.

Our present study showed that low skeletal muscle mass can reduce the incidence of colorectal inflammatory polyp by 63.1% in males with BMI<22.69kg/m2. Such a significant incidence reduction in this subgroup demonstrated a sex difference in the association between skeletal muscle mass and colorectal polyp. To identify whether this sex difference was a result of gonadal hormones or not, we evaluated the effect of skeletal muscle mass index on colorectal polyp in postmenopausal women (n=805). The skeletal muscle mass index did not have a significant association with colorectal polyp, including different pathological types (all p>0.05, Supplementary Table 5), which indicated that it was not due to gonadal hormones. Other gender-related habits like dietary and exercise histories might be associated with this sex difference in the correlation between skeletal muscle mass and colorectal polyp. However, in our study, data about dietary and exercise habits were lacking. A further study about the underlying mechanism of gender-specific correlation is requisite in the future.

Skeletal muscle mass could be easily detected by BIA or dual X-ray absorptiometry (DXA), is an indispensable part for diagnosis of sarcopenia.[25] Our results of this study demonstrated that detection of skeletal muscle may be helpful for the prediction of colorectal inflammatory polyp before colonoscopy.

Offering direct colonoscopy screening for the entire eligible population is not feasible in China, because of limited capacity of national health insurance and restricted public awareness of colorectal polyp. Thus, targeting high-risk population after risk-based stratification is a more efficient approach. Currently, most existing risk-based stratifications for colorectal cancer were developed based on the following risk factors: age, gender, family history, smoking, drinking and BMI.[8,51] However, there is no risk-score to predict colorectal inflammatory polyp up to now. Our results provided a new associated-factor (low muscle mass) to evaluate the presence of colorectal inflammatory polyp.

However, our study has the following limitations. Firstly, it was a cross-sectional study that could not define causality. Secondly, some data was absent, like exercise habit, measurement of muscle strength and family history of CRC. Finally, it was a single-center study, while the results need to be further validated in a multi-center study.

Conclusion

Generally, skeletal muscle mass could be helpful to identify the presence of colorectal polyp in Chinese asymptomatic population, especially in males. Additionally, low SMI kept independent effect on presence of inflammatory polyp and serrated polyp, rather than conventional adenoma. Moreover, there was an effect modification of BMI in terms of the association between skeletal muscle mass and colorectal inflammatory polyp.

Data Sharing Statement

The data could be acquired from the corresponding author on reasonable request.

Ethics Statement

The study was approved by the Institutional Review Board (IRB) of the First Affiliated Hospital of Wenzhou Medical University. Due to its cross-sectional nature, the consent was waived by the IRB and the data was anonymous. All data was extracted from electronic medical records and analyzed in accordance with the principles of the Declaration of Helsinki.

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Disclosure

The authors declare no conflict of interest.

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