Preplanned Studies

Evaluation of the Long-Term Benefits and Cost-Effectiveness of Colorectal Cancer Screening for Populations with Excess Weight — China, 2023

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Summary

What is already known on this topic?

China has the world's largest population of individuals who are overweight or obese, contributing to the growing burden of colorectal cancer (CRC). Screening is an effective strategy for reducing CRC mortality and incidence.

What is added by this report?

Using a simulation model, we found that CRC screening reduces incidence and mortality across all body mass index groups (normal, overweight, and obese) in China, with greater quality-adjusted life-year gains and 6%–14% higher colonoscopy efficiency in individuals who are overweight or obese. Screening proved to be more cost-effective for these groups, despite high lifetime healthcare expenditures.

What are the implications for public health practice?

CRC screening in China can prioritize populations with excess weight and incorporate weight management to improve health outcomes and control long-term healthcare costs.

ABSTRACT

Introduction: Individuals with excess body weight have elevated colorectal cancer (CRC) risk. This study aimed to evaluate the long-term efficacy and cost-effectiveness of CRC screening strategies in populations with excess weight.

Methods: A multistate Markov model was used to evaluate the efficacy and cost-effectiveness of CRC screening. Three hypothetical cohorts were simulated based on body mass index (BMI) subgroups: normal, overweight, and obese. Screening strategies included colonoscopy (every 10 years) or an annual fecal immunochemical test, initiated at ages 45 and 50. Key outcomes included CRC cases, deaths, quality-adjusted life-year (QALY), lifetime costs, endoscopic resource use, and incremental cost-effectiveness ratios.

Results: QALY gains increased from 0.097 [95% confidence interval (*CI*): 0.091–0.102] in individuals with normal weight to 0.104 (0.101–0.107) in those who were overweight and 0.108 (0.105–0.111) in those who were obese. Individuals who were overweight or obese demonstrated 6%–14% greater colonoscopy efficiency compared with those of normal weight. All screening strategies were cost-effective (incremental cost-effectiveness ratio=USD 671–USD 949 per QALY gained), with a marginal decrease in cost per QALY gained observed at higher BMI. Despite improved cost-effectiveness, lifetime healthcare expenditures were higher in individuals who were overweight ($845.19–$955.00) and obese ($1,358.00–$1,467.37) than in those with normal weight ($119.62–$229.20).

Conclusion: CRC screening in China demonstrated effectiveness and cost-effectiveness across BMI groups, with populations with excess weight showing high colonoscopy resource efficiency. Amid rising lifetime healthcare costs attributable to high BMI, integrating weight management with CRC screening is critical for optimizing health and economic benefits.

Colorectal cancer (CRC) is the second most common cancer and the fourth leading cause of cancer-related deaths in China (*1*). Screening is an effective strategy for reducing both mortality and disease burden (*2*). Current screening guidelines primarily use age and family history of CRC as eligibility criteria, overlooking modifiable risk factors, such as being overweight or obese. This limitation may compromise the efficiency of CRC screening programs.

China is experiencing a sharp increase in obesity, with a relative increase of 144.2% from 1990 to 2021

(*3*), driven by rapid socioeconomic development and lifestyle changes. The country currently has the world's largest population of individuals who are overweight or obese, and this trend is projected to impose an economic burden of CNY 418 billion by 2030 (*3*). As established independent risk factors for CRC, overweight and obesity contribute to 7.4% of the national CRC burden and represent the most financially burdensome among body mass index (BMI)-associated cancers (*4*). These findings highlight the urgent need for tailored CRC screening and management in individuals with excess weight.

Colonoscopy and fecal immunochemical testing (FIT) are the most widely used CRC screening modalities and are cost-effective in average-risk populations. While individuals with excess weight have a higher risk of CRC, they also face increased competing health risks and high medical costs, which may reduce the overall clinical and economic benefits of screening. Therefore, the long-term health outcomes and cost-effectiveness of CRC screening, specifically in populations with excess weight in China, remain unclear.

To address these gaps, we constructed a multistate Markov model to simulate the long-term health outcomes and cost-effectiveness of CRC screening strategies in populations with weight excess. This study provides policymakers with evidence to optimize screening programs and mitigate the rising burden of obesity-associated CRC.

Our validated CRC simulation model (CRC-SIM) reproduces the natural history, screening interventions, and clinical management of CRC. Nine health states were included: normal epithelium, non-advanced adenoma, advanced adenoma, CRC stages I–IV, and terminal states (CRC-related and other deaths), as detailed in Supplementary Figure S1 (available at https://weekly.chinacdc.cn/). The model incorporated BMI-specific modifications for CRC risk, all-cause mortality, and obesity-associated costs.

We simulated three hypothetical population cohorts (N=100,000 per cohort), based on BMI strata: normal weight (18.5–23.9 kg/m^2) and excess-weight populations (≥24 kg/m^2). The excess-weight group was further divided into overweight (24–27.9 kg/m^2) and obese (≥28 kg/m^2) subgroups according to China's BMI standards (*5*). All individuals entered the model at age 40 and were followed until age 79 or death, whichever occurred first. We modeled screening using colonoscopy (every 10 years) or annual FIT, initiated at ages 45 or 50.

A complete list of the variables and data sources used in our simulation model is provided in Supplementary Table S1 (available at https://weekly.chinacdc.cn/). Transitional probabilities for natural history were derived from systematic reviews and calibrated to age-specific CRC incidence and mortality using the Global Burden of Disease data (https://ghdx.healthdata.org/). Health utilities were obtained from a cross-sectional study of 300 newly diagnosed patients with CRC in China, with utilities of 0.768, 0.655, 0.562, and 0.495 for CRC stages I through IV, respectively (*6*). Cost parameters included screening, clinical management, travel expenses, and productivity losses. The BMI-specific CRC risk was derived from a population-based CRC screening program in China (*7*). The association between BMI and overall mortality was derived from a large population-based cohort study of 3.6 million individuals (*8*). All risks were adjusted by the prevalence of overweight and obesity reported in the *Report on the Nutrition and Chronic Diseases Status of Chinese Residents 2020,* with relative risks for CRC incidence of 1.04 (overweight) and 1.12 (obesity) and for all-cause mortality of 1.05 (overweight) and 1.22 (obesity) (*9*). Additional healthcare costs associated with overweight and obesity were derived from a longitudinal study on individual healthcare expenditures, which estimated annual costs of $44.02 for overweight and $75.79 for obese individuals (*10*). All parameters were incorporated into our Markov models, in which individuals transitioned annually between exclusive health states. Health utilities and costs were assigned to each state to calculate QALYs and lifetime costs.

We estimated CRC cases, deaths, QALYs, lifetime costs, endoscopic resources, and incremental cost-effectiveness ratios per person, comparing each strategy with no screening. Cost-effectiveness was assessed against a willingness-to-pay threshold of US$18,364/QALY. All costs were discounted by 5% annually according to the China Guidelines for Pharmacoeconomic Evaluations, with application of a half-cycle correction. Analyses were performed using R software (version 3.6.0; R Foundation for Statistical Computing, Vienna, Austria) and TreeAge Pro 2022 (TreeAge Software Inc., Williamstown, MA, USA).

Table 1 reveals distinct patterns in clinical outcomes across BMI categories (normal weight, overweight, and obese). In the absence of screening, CRC-specific mortality was higher among individuals who were overweight (2,420 deaths per 100,000) and obese

TABLE 1. Lifetime clinical outcomes of colorectal cancer screening strategies *vs*. no screening by body mass index group in 100,000 Chinese individuals (aged 40–79 years).

Indicators	No screening	50–74 years of age		45–74 years of age	
		Colonoscopy	FIT	Colonoscopy	FIT
Normal					
CRC cases (per 100,000)	4,013 (4,013, 4,013)	1,022 (1,020, 1,024)	1,566 (1,562, 1,570)	872 (870, 875)	1,334 (1,329, 1,338)
Cases prevented (per 100,000)	ref	2,991 (2,989, 2,993)	2,447 (2,443, 2,451)	3,141 (3,138, 3,143)	2,679 (2,675, 2,684)
Cases prevented (%)	ref	74.53	60.97	78.27	66.76
CRC deaths (per 100,000)	2,264 (2,264, 2,264)	565 (564, 566)	662 (661, 663)	416 (415,417)	514 (513, 515)
Deaths prevented (per 100,000)	ref	1,699 (1,698, 1,700)	1,602 (1,601, 1,603)	1,848 (1,847, 1,849)	1,750 (1,749, 1,751)
Deaths prevented (%)	ref	75.05	70.76	81.63	77.21
QALYs (per person)	16.18 (16.176, 16.182)	16.28 (16.273, 16.278)	16.26 (16.252, 16.258)	16.30 (16.292, 16.297)	16.27 (16.267, 16.273)
Additional QALY gain	ref	0.097 (0.091, 0.102)	0.076 (0.070, 0.082)	0.116 (0.110, 0.121)	0.091 (0.085, 0.097)
Overweight					
CRC cases (per 100,000)	4,281 (4,281, 4,281)	1,121 (1,119, 1,123)	1,698 (1,694, 1,702)	950 (947, 952)	1,442 (1,438, 1,446)
Cases prevented (per 100,000)	ref	3,160 (3,158, 3,162)	2,583 (2,579, 2,587)	3,331 (3,329, 3,334)	2,839 (2,835, 2,843)
Cases prevented (%)	ref	73.81	60.33	77.81	66.22
CRC deaths (per 100,000)	2,420 (2,420, 2,420)	617 (616, 618)	720 (719, 721)	453 (452,454)	558 (556, 559)
Deaths prevented (per 100,000)	ref	1,803 (1,802, 1,804)	1,700 (1,699, 1,701)	1,967 (1,966, 1,968)	1,862 (1,861, 1,864)
Deaths prevented (%)	ref	74.50	70.25	81.28	77.04
QALYs (per person)	16.016 (16.013, 16.019)	16.120 (16.117, 16.123)	16.098 (16.110, 16.101)	16.141 (16.138, 16.144)	16.114 (16.111, 16.117)
Additional QALY gain	ref	0.104 (0.101, 0.107)	0.081 (0.079, 0.084)	0.125 (0.122, 0.127)	0.098 (0.095, 0.101)
Obese					
CRC cases (per 100,000)	4,502 (4,502, 4,502)	1,213 (1,211, 1,215)	1,828 (1,824, 1,833)	1,020 (1,018, 1,022)	1,550 (1,545, 1,554)
Cases prevented (per 100,000)	ref	3,289 (3,287, 3,291)	2,674 (2,669, 2,680)	3,482 (3,480, 3,484)	2,952 (2,948, 2,957)
Cases prevented (%)	ref	73.06	59.40	77.34	65.57
CRC deaths (per 100,000)	2,550 (2,550, 2,550)	665 (664, 666)	775 (773, 776)	487 (486,488)	599 (598, 600)
Deaths prevented (per 100,000)	ref	1,885 (1,884, 1,886)	1,775 (1,774, 1,777)	2,063 (2,062, 2,064)	1,951 (1,950, 1,952)
Deaths prevented (%)	ref	74.08	69.59	80.90	76.51
QALYs (per person)	15.844 (15.841, 15.847)	15.952 (15.949, 15.955)	15.929 (15.926, 15.932)	15.974 (15.972, 15.977)	15.946 (15.944, 15.949)
Additional QALY gain	ref	0.108 (0.105, 0.111)	0.084 (0.082, 0.087)	0.130 (0.127, 0.133)	0.102 (0.099, 0.105)

Note: Three hypothetical population cohorts (*N*=100,000 per cohort) based on body mass index strata were considered in our study: normal weight (18.5–23.9 kg/m^2), overweight (24–27.9 kg/m^2), and obese (≥28 kg/m^2), according to China's body mass index standards. All individuals entered the model at age 40 and were followed until age 79 or death, whichever occurred first. Screening strategies included colonoscopy (every 10 years) or annual FIT, initiated at ages 45 or 50.
Abbreviation: FIT=fecal immunochemical test; CRC=colorectal cancer; QALY=quality-adjusted life-year; Ref=reference.

(2,550 per 100,000) than among those with normal weight (2,264 per 100,000). Regarding health utility, individuals with obesity had the lowest overall QALYs [15.844, 95% confidence interval (*CI*): 15.841–15.847], followed by those who were overweight (16.016, 95% *CI*: 16.013–16.019) and those with normal weight (16.179, 95% *CI*: 16.176–16.182).

Screening significantly reduced CRC cases (59.40%–78.27%) and deaths (69.59%–81.63%) and increased QALYs gained (0.076–0.130) relative to no screening. The number of prevented CRC cases and

deaths was comparable across BMI categories. Specifically, among individuals initiating colonoscopy at age 50, CRC case prevention rates were 74.53% for those with normal weight, 73.81% for those who were overweight, and 73.06% for those who were obese, with corresponding mortality reductions of 75.05%, 74.50%, and 74.08%, respectively. Concurrently, QALY gains increased from 0.0967 (95% *CI*: 0.091–0.102) in individuals with normal weight to 0.104 (0.101–0.107) in those who were overweight and 0.108 (0.105–0.111) in those who were obese. The disparity in QALY gains between higher-BMI and normal-weight groups widened when screening was initiated earlier (Table 1).

A high BMI was associated with improved colonoscopy efficiency. Compared with individuals with normal weight, those who were overweight and obese required fewer colonoscopies per case prevented (6%–8% and 10%–14%, respectively) and per death prevented (6%–8% and 10%–13%, respectively). This trend remained consistent across screening strategies and initiation ages (Table 2).

Both colonoscopy and FIT strategies were cost-effective (incremental cost-effectiveness ratio

TABLE 2. Lifetime economic burden and endoscopic resource use for colorectal cancer screening strategies *vs*. no screening by body mass index group in 100,000 Chinese individuals (aged 40–79 years).

Indicators	No screening	50–75 years of age		45–75 years of age	
		Colonoscopy	FIT	Colonoscopy	FIT
Normal					
Cost per person (USD)	119.62 (119.54, 119.71)	194.03 (193.63, 194.44)	171.85 (171.62, 172.07)	229.20 (228.64, 229.76)	183.85 (183.58, 184.13)
Colonoscopies per person		2.71 (2.71, 2.71)	1.25 (1.24, 1.25)	3.53 (3.53, 3.53)	1.45 (1.45, 1.45)
No. of colonoscopies per case prevented	Not applicable	160	78	191	83
No. of colonoscopies per death prevented		91	51	112	54
Overweight					
Cost per person (USD)	845.19 (845.10, 845.29)	920.50 (920.09, 920.91)	899.87 (899.64, 900.11)	955.00 (954.43, 955.58)	911.62 (911.33, 911.91)
Colonoscopies per person		2.67 (2.67, 2.67)	1.24 (1.24, 1.24)	3.46 (3.46, 3.46)	1.44 (1.44, 1.45)
No. of colonoscopies per case prevented		148	73	176	78
No. of colonoscopies per death prevented		84	48	104	51
Prevented cases compared to normal weight individual (%)	Not applicable	7	6	8	6
Prevented deaths compared to normal weight individual (%)		7	6	8	6
Obese					
Cost per person (USD)	1,358.00 (1,357.90, 1,358.10)	1,433.79 (1,433.38, 1,434.20)	1,414.98 (1,414.73,1,415.22)	1,467.37 (1,466.80, 1,467.94)	1,426.42 (1,426.12, 1,426.71)
Colonoscopies per person		2.62 (2.62, 2.62)	1.23 (1.23, 1.23)	3.38 (3.38, 3.38)	1.43 (1.43, 1.44)
No. of colonoscopies per case prevented		139	69	164	74
No. of colonoscopies per death prevented		80	46	97	49
Prevented cases compared to normal weight individual (%)	Not applicable	13	11	14	11
Prevented deaths compared to normal weight individual (%)		12	10	13	10

Note: Three hypothetical population cohorts (*N*=100,000 per cohort) based on body mass index strata were considered in our study: normal weight (18.5–23.9 kg/m^2), overweight (24–27.9 kg/m^2), and obese (≥28 kg/m^2), according to China's body mass index standards. All individuals entered the model at age 40 and were followed until age 79 or death, whichever occurred first. Screening strategies included colonoscopy (every 10 years) or annual FIT, initiated at ages 45 or 50.
Abbreviation: USD=United States dollar; FIT=fecal immunochemical test.

TABLE 3. Incremental cost-effectiveness for each screening strategy compared with no screening by body mass index in 100,000 Chinese individuals (aged 40–79 years).

Strategies	ICER (USD/QALYs)		
	Normal	Overweight	Obesity
Colonoscopy *vs*. no screening, 50 years of age	769	725	703
Annul FIT *vs*. no screening, 50 years of age	686	671	675
Colonoscopy *vs*. no screening, 45 years of age	949	882	840
Annul FIT *vs*. no screening, 45 years of age	706	679	671

Note: Incremental QALYs and costs were compared with no screening. Three hypothetical population cohorts (*N*=100,000 per cohort) based on body mass index strata were considered in our study: normal weight (18.5–23.9 kg/m^2), overweight (24–27.9 kg/m^2), and obese (≥ 28 kg/m^2), according to China's body mass index standards. All individuals entered the model at age 40 and were followed until age 79 or death, whichever occurred first. Screening strategies included colonoscopy (every 10 years) or annual FIT, initiated at ages 45 or 50.
Abbreviation: QALYs=quality-adjusted life-years; USD=United States dollar; ICERs=incremental cost-effectiveness ratios; FIT=fecal immunochemical test.

<$18,364/QALY) across all BMI categories compared with no screening (Table 3). Most screening modalities showed progressively decreasing costs per QALY gained with increasing BMI ($769, $725, and $703 per QALY gained for individuals with normal weight, overweight, and obesity, respectively, when initiated at age 50). Despite improved cost-effectiveness of screening, lifetime healthcare expenditures were higher in those who were overweight ($845.19–$955.00) and obese ($1,358.00–$1,467.37) than in those with normal weight ($119.62–$229.20) (Table 2).

DISCUSSION

We constructed a multistate Markov model to simulate the long-term health outcomes and cost-effectiveness of CRC screening in populations with excess weight. Our study demonstrates that CRC screening reduces both incidence and mortality across all BMI groups (normal weight, overweight, and obese) in China. Individuals who are overweight or obese derive greater QALY gains and resource efficiency (6%–13% fewer colonoscopies per CRC case and death prevented) than those with normal weight. Notably, most screening strategies proved to be cost-effective, with a marginal decrease in cost per QALY gained as BMI increased.

Few modeling studies have evaluated the cost-effectiveness of CRC screening across BMI groups. Our findings show that targeting populations with overweight or obesity yields greater QALY gains and improved cost-effectiveness compared with targeting populations with normal weight, consistent with results from a prior German modeling study (*11*). This enhanced benefit is likely owing to the high prevalence and faster progression of adenomas in individuals with a high BMI, which increases the yield of CRC screening. Our analysis further revealed that screening these populations also improves colonoscopy efficiency, requiring fewer procedures for CRC death prevention. These findings provide compelling evidence for prioritizing individuals with overweight or obesity in CRC screening programs in resource-limited settings.

A national screening study revealed significantly lower adherence to CRC screening among individuals with obesity (38.7% *vs*. 55.8% among those with normal weight) (*12*). This reduced uptake persisted despite free colonoscopic access [odds ratio (*OR*)=2.16] (*13*). Insufficient risk awareness may have contributed to this disparity. Additionally, individuals with a high BMI incur substantially higher lifetime healthcare expenditures than those with normal weight, primarily because of obesity-related comorbidity management. These results underscore the critical need to integrate BMI management into the CRC screening continuum to optimize health and economic benefits.

The strengths of our study include: (*1*) a comprehensive evaluation incorporating CRC risk, competing comorbidities, and obesity-attributable costs; (*2*) assessment of multiple screening initiation ages to address the rising burden of early-onset CRC; and (*3*) estimation of resource demand and costs, providing essential evidence for resource-limited regions. Importantly, our model was specifically adapted to reflect the distinct epidemiological patterns of CRC and obesity in China, thereby generating tailored, policy-relevant evidence.

This study has at least three limitations. First, it primarily relied on the adenoma–carcinoma sequence (70%–90% of CRC cases) because of insufficient Chinese data on serrated pathways. Second, we did not consider emerging screening technologies (including

mt-sDNA) owing to the lack of population-based evidence in China. Future evaluations should include novel technologies when Chinese-specific data become available. Finally, more effective obesity markers (including central adiposity metrics) should be incorporated to optimize obesity-specific risk stratification.

Our study highlights that CRC screening in China is cost-effective across BMI groups, with individuals who are overweight or obese showing high colonoscopy resource efficiency. Based on these results, we recommend that screening programs in China prioritize populations with a high BMI, particularly under resource constraints. Furthermore, amid rising healthcare costs caused by obesity and related comorbidities, integrating weight management into CRC screening is essential for optimizing screening efficacy and long-term cost containment.

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SUPPLEMENTARY MATERIALS

OVERVIEW OF THE MODEL

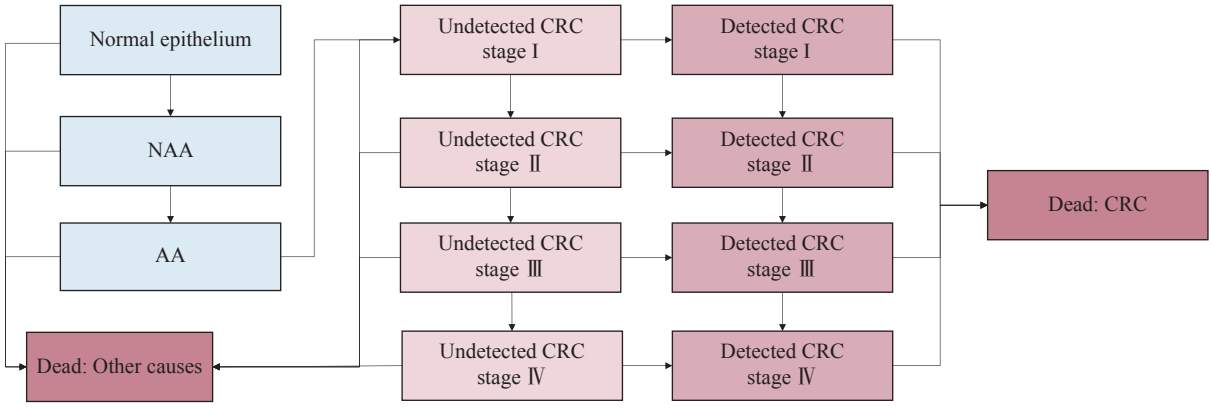
The Colorectal Cancer (CRC) Screening Simulation model was constructed using TreeAge Pro 2022 to simulate the natural history, screening, and treatment of CRC in a hypothetical population. The model incorporates nine mutually exclusive health states: normal epithelium; non-advanced adenoma; advanced adenoma; CRC stages I–IV; CRC death; and death from other causes (Supplementary Figure S1). Guided by the clinical characteristics of the Chinese population and large-scale cancer screening program implementations, non-advanced adenoma and advanced adenoma states were included to model the progression of colorectal precancerous lesions. The model assumes that all CRC arises via the adenoma–carcinoma sequence, accounting for approximately 80% of all CRC cases. Diagnosed CRC is represented as a mutually exclusive state; once an individual is diagnosed, CRC progression halts, and they transition to the corresponding management pathways. The model features two absorbing states: death from other causes and CRC-related death.

The natural history transition probabilities were derived from a systematic review. Without screening, individuals may still be diagnosed with CRC through symptomatic presentations or incidental findings during the investigation of other health conditions. A model calibration approach was employed to ascertain these parameter values. The methods and results are presented in Supplementary Table S1. Age-specific all-cause, CRC, and non-CRC mortality rates in China were derived from the China Statistical Yearbook. Other-cause mortality was calculated as follows: $\mathrm{Oth}_{\mathrm{Cause}_{\mathrm{Mort}}(\mathrm{age})} = \mathrm{All\_Cause\_Mort}\,(\mathrm{age}) \times (1 - (\mathrm{N\_CRC}_{\mathrm{Deaths}}\,(\mathrm{age})\,/\mathrm{N\_All\_Deaths}\,(\mathrm{age}))$.

CRC Risk and Mortality by Body Mass Index (BMI) and Risk Modification

CRC risks by BMI strata were derived from a population-based CRC screening program in China that included 182,927 participants (*1*), with detailed estimates provided in Supplementary Table S1. Mortality by BMI strata was derived from an international multicenter cohort study, and the estimated relative risk was obtained from the Chinese subgroup (*2*).

Model implementation required calculating CRC risk by BMI stratum relative to the population-average risk (i.e., relative to the model's original calibration), not relative to the normal-weight group. To derive these estimates, we accounted for the proportional distribution of each BMI stratum in the population during the calibration period, ensuring that aggregating stratum-specific relative risks yielded the population-average CRC risk. We used prevalence data on overweight and obesity from the *Report on the Nutrition and Chronic Diseases Status of Chinese Residents 2020* (*3*), which were consistent with findings from consecutive nationally representative surveys (*4*) and a large cross-sectional study in China (*5*). Based on these data, we generated BMI-stratified CRC relative risks compared with population-average risks (*6*). The modified relative risks are provided in Supplementary Table S1.



SUPPLEMENTARY FIGURE S1. Schematic of the colorectal cancer screening simulation model.
Abbreviation: NAA=non-advanced adenoma; AA=advanced adenoma; CRC=colorectal cancer.

TABLE S1. Parameters of the Colorectal Cancer Screening Simulation model.

Parameters	Base case value	Reference
Nature history		
Normal to NAA	Age-dependent, range from 0.0004 to 0.0345	Calibration
NAA to AA	0.020	(*12*–*13*)
AA to preclinical CRC	0.044	(*12*)
CRC I-II	0.300	
CRC II- III	0.450	(*14*)
CRC III- IV	0.500	
Preclinical CRC I-II to diagnosis	0.190	
Preclinical CRC III to diagnosis	0.430	(*15*)
Preclinical CRC IV to diagnosis	0.720	
CRC I to death	0.032	
CRC II to death	0.041	Estimated though systematic review (*16*)
CRC III to death	0.106	
CRC IV to death	0.214	
Heath utility		
No colorectal lesion & false positive	1.000	
NAA	0.955	
AA	0.955	
CRC		
CRC stage 1	0.768	(*17*–*18*)
CRC stage 2	0.656	
CRC stage 3	0.562	
CRC stage 4	0.495	
Death	0	
Screening cost		
FIT[1]	2.17	(*19*)
Colonoscopy	72.47	
Time lost from FIT	2.22	
Travel cost from FIT	0.07	
Pathology	19.43	(*17*)
Travel cost from clinical screening	0.76	
Time lost from clinical screening	7.6	
Treatment for complications	154.57	
Direct medical and non-medical cost of treatment (USD)[1]		
NAA	189.29	
AA		
Surgery	2657.3	
Endoscopic mucosal resection	424.12	
Precent of AA receiving surgery	0.027	(*17*)
CRC Stage I	9944.76	
CRC Stage II	10627.79	
CRC Stage III	11928.97	
CRC Stage IV	14665.51	

Continued

Parameters	Base case value	Reference
Indirect cost of treatment (USD)		
AA - surgery	520.59	
AA - endoscopic mucosal resection	83.09	
Stage I	1895.56	(17)
Stage II	1927.94	
Stage III	2441.06	
Stage IV	3158.44	
Screening performance		
Colonoscopy		
Sensitivity for NAA	85%	(20)
Sensitivity for AA	95%	(20)
Sensitivity for preclinical CRC & CRC	95%	(20)
Specificity of colonoscopy	86%	(20)
FIT		
Sensitivity for NAA	8.7%	(21)
Sensitivity for AA	20.3%	(21)
Sensitivity for preclinical CRC & CRC	78.9%	(21)
Specificity of FIT	95%	(22)
CRC Risk and Mortality by BMI		
Modified incidence RR for normal	0.93	(1)
Modified incidence RR for overweight	1.04	(1)
Modified incidence RR for obesity	1.12	(1)
Modified all-cause mortality RR for normal	0.90	(23)
Modified all-cause mortality RR for overweight	1.05	(23)
Modified all-cause mortality RR for obesity	1.22	(23)

Abbreviations: AA=advanced adenoma; CRC=colorectal cancer; NAA=non-advanced adenoma; FIT=fecal immunochemical test.

Colonoscopy Complications in Individuals with Overweight and Obesity

We incorporated findings from a published systematic review investigating the association between overweight/obesity and colonoscopy complications (*7*). The review reported that the only well-studied colonoscopy outcome related to obesity was poorer bowel preparation in individuals with overweight or obesity (*8*). No high-quality evidence was found regarding risks associated with moderate sedation or colonoscopy specifically in these populations (*9*). Published studies have not shown significantly increased rates of acute coronary syndrome or cerebrovascular accident associated with major cardiac or colorectal surgery in individuals with overweight or obesity (*10*).

Medical Costs of Overweight and Obesity

Additional per capita healthcare costs associated with overweight and obesity were derived from a longitudinal study of individual-level healthcare expenditures. The study reported annual additional costs of $44.02 for individuals with overweight and $75.79 for those with obesity (*11*).

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