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Lingyue Zhao[1], Chunsheng Cheng[2], Guozhen Ma[1], Mang ju[3], u Fen Xingguang Wang[1]

[1]Department of Day Surgery [2]Department of Endoscopy [3]Department of Anaesthesia Medicine. Shenzhen Nanshan People's Hospital. Shenzhen People's Republic of China

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Corresponding author: Lingyue Zhao. Department Management Centre. Shenzhen Nanshan People's Hospital. 1017, Donmeng Rd N. Shenzhen, Guangdong 518020. People's Republic of China
e-mail: 18565887795@163.com

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ABSTRACT

Introduction: rectal polyps are a common precancerous condition, and dietary habits are hypothesized to influence their development.

Objective: this study aims to investigate the causal association between genetically predicted dietary habits and the risk of rectal polyps.

Methods: we utilized summary data from genome-wide association studies (GWAS) on dietary habits and rectal polyps in individuals of European ancestry, sourced from the latest International Epidemiology (IEU) dataset. A two-sample Mendelian Randomization (MR) approach was employed using the Inverse Variance Weighted (IVW) method, alongside weighted median, weighted mode, and MR-Egger regression methods. Sensitivity analyses were conducted, including MR-Egger, MR-PRESSO,

Cochran’s Q, and leave-one-out analyses, to assess the robustness of the findings.

Results: the IVW method revealed a significant association between processed meat intake and the risk of rectal polyps (IVW: OR = 0.9945, 95 % CI: 0.9892-0.9999, p = 0.045). However, no significant causal associations were observed between the remaining dietary habits and the risk of rectal polyps Sensitivity analyses revealed heterogeneity in the alcohol-rectal polyp association, but no pleiotropy or outliers. Beef intake-rectal polyp association showed a potential pleiotropy signal, but no outliers. Leave one out analysis confirmed robust results.

Conclusions: the MR study suggests a potential causal effect of processed meat intake on the risk of rectal polyps, highlighting the importance of dietary factors in the development of this condition. The findings underscore the need for further research to elucidate the biological mechanisms and to confirm these preliminary results.

Keywords: Mendelian randomization. Rectal po
Genome-wide association stu Genetic instrumental variables. Causal inference.

RESUMEN

Introducción: los pólipos rectales son una condición precancerosa común,
y se tiene la hipótesis de que los hábitos alimentarios in
desarrollo.

Objeti: investigar la asociación causal entre los hábitos alim
predichos genéticamente y el riesgo de pólipos rectales.

Método: se utilizaron datos resumidos de los estudios de asociacion
pangenómicas (GWAS) sobre hábitos alimentarios y pólipos
individuos de ascendencia europea, provenientes del último conjun

datos de la epidemiología internacional (IEU). Se empleó un enfoqu
aleatorización mendeliana (MR) de dos muestras utilizando el método de
ponderación de la varianza inversa (IVW), junto con la mediana ponderada,
el modo ponderado y los métodos de regresión de MR-Egger. Se realizaron
análisis de sensibilidad, incluyendo MR-Egger, MR-PRESSO, Q de Cochran y
leave-one-out, para evaluar la solidez de los hallazgos.

Resultados: el método de IVW reveló una asociación significativa entre el
consumo de carne procesada y el riesgo de pólipos rectales (IVW: OR
0,9945; IC d%: 0,9892-0, p = 0,045). Sin embargo, no s
observaron asociaciones causales
alimentarios restantes y el riesgo de pólipos rectales. La aso
ingesta de carne de buey y pólipos rectales mostró una señal potencial de
pleiotropía, pero no valores atípic*leave-one* confirmó
resultados sólidos.

Conclusiones: el estudio MR sugiere un posible efecto causal del consumo
de carne procesada en el riesgo de pólipos recta
importancia de los factores dietéticos en el desarrollo de esta afección. Los
hallazgos subrayan la necesidad de más investigación para dilucid
mecanismos biológicos y confirmar estos resultados preliminares.

Palabras: Aleatorización mendeliana. Pólipos r
alimentarios. EstuVaroisab
instrumentales. Genética. Inferencia causal.

INTRODUCTION

Rectal polyps, which are irregular growths on the lining of the rectum or colon, are predominantly benign but can be precancerous, posing a risk of

malignant transformation if unaddressed. These growths are notably common among adults, with a significant prevalence rate of 18.1 % within the adult population of China (1,2). The genesis of colorectal polyps is intricately tied to genetic factors, which are responsible for roughly 5 % to 6 % of occurrences, where a familial predisposition to colorectal cancer and genetic mutations are the most influential genetic elements (3). Among environmental factors, diet is considered to have a substantial impact (4). Therefore, this article primarily explores the causal relationship between rectal polyps and dietary habits.

Dietary habits encompass the dietary selections and consumption patterns that individuals adopt in their day-to-day routines. Maintaining wholesome dietary practices is crucial for overall health, whereas unhealthy eating habits can precipitate a range of health concerns, notably their influence on the development of rectal polyps (5). Clinical observational studies have reported associations between certain dietary factors and the prevalence of colorectal conditions, including polyps (6-8). For instance, high intake of red and processed meats has been linked to an increased risk of colorectal adenomas, which are precursors to malignant transformation (9). Conversely, a diet rich in fruits, vegetables, and fiber has been consistently associated with a reduced risk of colorectal neoplasia (10). A recent study has highlighted the potential impact of adolescent sugar and sugar-sweetened beverage intake on the risk of developing colorectal adenomas, particularly rectal adenomas (11). Despite these findings, the biological mechanisms underlying these associations are not fully understood, and these observational studies are prone to confounding and reverse causality, limiting the ability to establish causality. Therefore, our experiment uses MR Method to avoid such problems.

Mendelian randomization (MR) studies offer a unique opportunity to investigate the causal nature of the relationship between dietary habits and rectal polyps by leveraging genetic variants as instrumental variables. This approach is based on the principle that the assignment of genetic

variants is random with respect to environmental exposures, thus reducing the potential for confounding observed in traditional epidemiological studies (12,13). We utilized summary data from genome-wide association studies (GWAS) on dietary habits and rectal polyps in individuals of European ancestry from the latest UK Biobank (UKB) dataset (14). We will use multiple MR methods to assess the robustness of our findings and conduct sensitivity analyses to check for pleiotropy and heterogeneity. This method allows for the investigation of the potential causal effects of various dietary factors on rectal polyp development, providing insights that could inform preventive strategies and public health guidelines.

MATERIALS AND METHODS

In our research, single nucleotide polymorphisms (SNPs) ident genome-wide association studies (GWAS) were chosen to serve as genetic instrumental variables (IVs). A significant, adjusted two-sample Mendelian randomization (MR) study was founded on three fundam assumptions (21): 1) Assumption of Relevance: The IVs are strongly linked to the exposure variable. 2) Assumption of Independence: uncorrelated with any factors that could simultaneously affect the exposure and the outcome. 3) Assumption of Exclusion Restriction: The IVs do n impact the outcome through any causal pathwa influence on the exposure. Current MR methodologies, which incorpora the effects of pleiotropy, have investigated the possibility of bidirection causal associations. Ethical approval for this study was unnecessary, given that the GWAS data on which it was based had already r necessary ethical approval.

Data sources

The genome-wide association study (GWAS) data concerning rectal polyps and dietary habits are sourced from the latest UKB dataset, encompassing participants exclusively of E rectal polyp data comprises 2,800 cases and 460,210 controls. The dietary habits trait encompass a spectrum of dietary intakes, including alco intake frequency, poultry intake, fresh fruit inta intake, cereal intake, processed meat intake, beef intake, pork intake, non-oily fish intake, oily fish intake, salad or raw vegetable intake, tea intake, lamb or mutton intake, and fizzy drink intake. Add available in supplementary table I.

Instrumental variable selection

In this study, the instrumental variables (IVs) included were selected based on the following criteria: 1) SNPs significantly associated with dietary habits were identified, with a more lenient *p*-value threshold of $p < 5 * 10^{-6}$ applied for frizzy drink intake due to a limited number of SNPs, while a s threshold of $p < 5 * 10^{-8}$ was used for other dietary factors (15). 2) SNPs with a minor allele frequency (MAF) greater than 0.01 were selected. 3) SNPs exhibiting linkage disequilibrium (LD) were excluded based criteria of $R^2 < 0.001$ and a window size of 10,000 kilobases (kb). 4) In cases where the selected IVs were not present in the outcome's summary data, proxy SNPs with high LD ($R^2 > 0.8$) were sought to replace the original IVs. 5) The strength of each SNP within the IVs was assessed by calculating the F-statistic to mitigate the potential bias of weak instrument variables. The formula for the F-statistic is as follows: $R^2 = (N - 2) / (1 - R^2)$, where R^2 represents the proportion of variance in the exposure that is explained by the SNP within the IV, and the F-statistic should exceed a va (16,17).

MR analyses

The present analysis primarily employed the inverse variance method (IVW) to evaluate the causal association between dietary h and the risk of rectal polyps (18). This method calculates the odds ratio (OR) along with the 95 % confidence interval (CI) to assess the association.

The IVW method is the cornerstone for interpreting M computes the weighted average of effect sizes by assigning weights based on the inverse of the variance of each single nucleotide poly (SNP). In addition to the IVW method, several robustness c conducted, including the MR-Egger intercept (19), weighted median (20) and weighted mode methods (21). The MR-Egger approach accounts for the presence of an intercept and provides an accurate estimation of the causal effect even in the presence of pleiotropy bias. The w method presupposes that approximately half of the instrumental variables are valid, thereby assessing the causal association betwedietary habits and rectal polyps. All analyses in this study were performed usi "TwoSampleMR" package in R version 4.3.1. Visualization was achie through scatter plots and sensitivity analysis plots (22).

Sensitivity and pleiotropy analysis

Sensitivity analysis is crucial for detecting potent studies. This study utilized Cochran's Q test to assess heterogeneity among the IVs. A *p*-value greater than 0.05 indicates low heterogeneity, suggesting that the estimations among the instrumental vari varying and have minimal impact on the IVW results. Con impact of genetic pleiotropy on the estimation of the association effect, this study employed the MR-Egger regression method to explore the presence of horizontal pleiotropy. When the intercept of the MR-Egger regression is close to zero or statistically insignifi cant, it sugg

pleiotropy. Furthermore, the study utilized the MR pleiotropy residual sum and outlier (MR-PRESSO) method to detect potential outliers (S $p < 0.05$) and re-estimated the causal association after their thereby correcting for horizontal pleiotropy. Leave one out analysis was also conducted to test the robustness and consistency of the results.

RESULTS

Selection of IVs

In our Mendelian randomization (MR) study, we identified 14 dietary habits as exposures, each represented by a set of genetic instruments (SNPs). The number of SNPs associated with each exposure varied, with the count ranging from 8 to 100. When conducting MR analysis with rectal polyps as the outcome, we encountered 53 SNPs that did not match any information in the summary data, and for these unmatched SNPs, no proxies were found within the outcome data. The strength of these genetic instruments was indicated by the mean F-statistic, which ranged from 21.22 to 811.85 across exposures, suggesting strong validity. Additional details, including the number of SNPs and F-statistic ranges, are detailed in supplementary table II.

Mendelian randomization analysis

The Mendelian Randomization (MR) analysis was conducted to explore the potential causal associations between dietary habits and the risk of rectal polyps. The IVW method demonstrated a significant association between the intake of processed meat and the risk of rectal polyps (Fig. 2, IVW: OR = 0.9945, 95 % CI: 0.9892-0.9999, $p = 0.045$). This finding suggests that higher consumption of processed meat may contribute to an increased risk of developing rectal polyps.

Additionally, there is no significant causal associations between the remaining dietary habits and the risk of rectal polyps, including alcohol

intake frequency (Fig. 3, IVW: OR = 0.9997, 95 % CI: 0.9977-1.0016, p = 0.74) and beef intake (Fig. 4, IVW: OR = 1.0071, 95 % CI: 0.998-1.0162, p = 0.13). All detailed results are shown in table I.

Sensitivity analysis

Sensitivity analyses were performed to assess the robustness of the IVW results. The heterogeneity test results for the association between alcohol intake frequency and rectal polyps indicated a significant level of heterogeneity (p = 0.02), suggesting that caution should be exercised in interpreting these results. However, the MR-Egger test did not reveal any significant pleiotropy, suggesting that the observed associations are not likely a result of confounding factors, it is important to recognize that there may be other biological mechanisms involved that warrant further investigation. Furthermore, the pleiotropy test hinted at the possible influence of horizontal pleiotropy on the association between beef intake and rectal polyps, as denoted by the MR-Egger Intercept (p = 0.04). However, the absence of outliers in the MR-PRESSO analysis suggests that no single genetic variant exerts an undue influence on the findings, lending robustness to the results (Tables II and III).

DISCUSSION

This Mendelian Randomization (MR) study aimed to investigate the causal association between genetically predicted dietary habits and the risk of rectal polyps, utilizing data from genome-wide association studies (GWAS) in individuals of European ancestry. While the study revealed a potential causal effect of processed meat intake on rectal polyps, supporting the need for further research to elucidate the underlying biological mechanisms and confirm these preliminary results.

Our findings suggest a protective effect of processed meat intake on the development of rectal polyps, a result that may be attributed to the high biological value of proteins and essential nutrients present in processed meats, some of which may have greater bioavailability than alternative

sources (23). Notably, certain nutrients in processed meat have been identified as being in short supply in the diets of specific populations, a factor that aligns with our study's outcomes (24). Despite inconsistent observational studies (25) suggesting that processed meats may promote the occurrence of polyps, our study offers a valuable perspective on the potential protective factors, diverging from previous observational studies (26,27).

However, our findings contrast with a German cross-sectional study (9), which found no significant association between the intake of processed meat and the prevalence of any adenomas or advanced adenomas. This discrepancy may be attributed to the design of the study, as cross-sectional studies cannot establish causality and are susceptible to selection bias. Moreover, the German study focused on individuals undergoing colonoscopy, which could introduce a health awareness bias that might skew the results. Conversely, a Chinese cohort study (25) supports our results, showing a positive correlation between processed meat intake and the prevalence of small polyps. The detailed analysis of polyps of varying sizes and numbers in this study enhances our understanding of how processed meat consumption relates to polyp development. It is also important to consider the dose-response effect, suggesting that moderate intake of processed meat might have a lesser potential for harm. In plain terms, there is a possibility that the nutritional benefits derived from moderate consumption of processed meat could outweigh the potential risks, thereby exhibiting a protective effect. This notion implies that a balanced intake of processed meat, rich in essential nutrients, might contribute more to nutritional value than cause harm, aligning with our study's outcomes that indicate a protective role at certain levels of intake.

Our study employs a two-sample Mendelian Randomization approach to robustly investigate the causality between dietary habits and rectal polyps, avoiding the biases of traditional observational studies (28). Utilizing a range of MR methods, alongside sensitivity analyses like MR-

PRESSO, we provide a comprehensive and nuanced evaluation. The study's strength is further enhanced by a large dataset from the UKB , offering ample statistical power to detect subtle associations (29). However, the potential heterogeneity in the relationship between alcohol consumption and rectal polyps, as indicated by the MR-Egger test, necessitates cautious interpretation. Additionally, the study's focus on specific dietary factors and its restriction to a European ancestry cohort may limit the generalizability of the findings, highlighting the need for broader dietary research and validation across diverse populations.

In conclusion, while the current MR study primarily focused on identifying dietary factors associated with an increased risk of rectal polyps, it also provides valuable insights into the potential protective role of certain dietary habits. Future research should aim to investigate a broader range of dietary factors, explore the biological mechanisms underlying their protective effects, and assess their generalizability across diverse populations. This research could provide valuable insights into the prevention and management of rectal polyps, ultimately contributing to the reduction of colorectal cancer risk.

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Table I. The Mendelian randomization results of the causal association between dietary habits and rectal polyps

Exposure	**Outcome**	**Gene significance *p***	**Methods**	**N. SNPs**	**OR (95 % CI)**	***p***
Lamb/Mutton intake	Rectal polyp	$< 5 * 10^{-8}$	IVW	25	0.9969 (0.9902-1.0036)	0.36
			MR-Egger	25	0.9828 (0.9496-1.0172)	0.33
			Weighted median	25	0.9969 (0.9876-1.0063)	0.51
			Weighted mode	25	0.9988 (0.9811-1.0169)	0.9
Cereal intake		$< 5 * 10^{-8}$	IVW	34	0.9996 (0.9952-1.0041)	0.87
			MR-Egger	34	1.0054 (0.9857-1.0255)	0.6
			Weighted median	34	0.9987 (0.9928-1.0047)	0.68
			Weighted mode	34	0.9974 (0.9869-1.0079)	0.62
Non-oily fish intake		$< 5 * 10^{-8}$	IVW	10	0.9925 (0.9821-1.003)	0.16
			MR-Egger	10	0.9708 (0.9185-1.0262)	0.33

			Weighted median	10	0.9899 (0.9775-1.0025)	0.12
			Weighted mode	10	0.9877 (0.9714-1.0043)	0.18
Salad/Raw vegetable intake		< $5 * 10^{-8}$	IVW	17	0.9999 (0.9913-1.0087)	0.99
			MR-Egger	17	1.0132 (0.9587-1.0708)	0.65
			Weighted median	17	1.0014 (0.9896-1.0133)	0.82
			Weighted mode	17	1.0031 (0.9843-1.0222)	0.75
Oily fish intake		< $5 * 10^{-8}$	IVW	55	1.0009 (0.9975-1.0043)	0.6
			MR-Egger	55	0.9969 (0.9813-1.0128)	0.7
			Weighted median	55	1.0002 (0.9952-1.0052)	0.94
			Weighted mode	55	0.9994 (0.9904-1.0085)	0.9
Frizzy drink intake		< $5 * 10^{-6}$	IVW	5	1.002 (0.9939-1.0102)	0.63
			MR-Egger	5	1.0228 (0.9857-1.0613)	0.32
			Weighted	5	1.0048 (0.9955-	0.32

			median		1.0142)	
			Weighted mode	5	1.0058 (0.995-1.0167)	0.35
Beef intake		< 5 * 10^{-8}	IVW	13	1.0071 (0.998-1.0162)	0.13
			MR-Egger	13	0.9466 (0.8976-0.9983)	0.07
			Weighted median	13	1.007 (0.9958-1.0184)	0.22
			Weighted mode	13	1.0099 (0.9898-1.0304)	0.35
Fresh fruit intake		< 5 * 10^{-8}	IVW	48	1.0012 (0.9953-1.0071)	0.7
			MR-Egger	48	1.0017 (0.9789-1.025)	0.89
			Weighted median	48	0.9983 (0.9897-1.007)	0.7
			Weighted mode	48	0.9956 (0.9835-1.0078)	0.48
Pork intake		< 5 * 10^{-8}	IVW	13	0.9995 (0.9879-1.0112)	0.93
			MR-Egger	13	0.9698 (0.882-1.0663)	0.54
			Weighted median	13	0.9968 (0.9835-1.0102)	0.63

			Weighted mode	13	0.9824 (0.9582-1.0071)	0.19
Alcohol intake frequency		< 5 * 10^{-8}	IVW	84	0.9997 (0.9977-1.0016)	0.74
			MR-Egger	84	1.0026 (0.9946-1.0107)	0.53
			Weighted median	84	1.0007 (0.9981-1.0034)	0.59
			Weighted mode	84	1.0018 (0.9974-1.0062)	0.42
Tea intake		< 5 * 10^{-8}	IVW	36	1 (0.9969-1.0031)	0.99
			MR-Egger	36	1.0035 (0.9964-1.0106)	0.34
			Weighted median	36	1.0014 (0.9969-1.0059)	0.55
			Weighted mode	36	1.0007 (0.9955-1.006)	0.79
Processed meat intake		< 5 * 10^{-8}	IVW	20	0.9945 (0.9892-0.9999)	0.045
			MR-Egger	20	0.9823 (0.9442-1.022)	0.39
			Weighted median	20	0.9931 (0.9858-1.0005)	0.07
			Weighted	20	0.993 (0.982-1.0041)	0.23

			mode			
Poultry intake		< 5 * 10^{-8}	IVW	7	1.0033 (0.9917-1.015)	0.58
			MR-Egger	7	0.9568 (0.6795-1.3474)	0.81
			Weighted median	7	1.0078 (0.9928-1.0231)	0.31
			Weighted mode	7	1.0104 (0.9862-1.0351)	0.44
Cooked vegetable intake		< 5 * 10^{-8}	IVW	17	1.0014 (0.9934-1.0094)	0.74
			MR-Egger	17	0.9701 (0.8884-1.0593)	0.51
			Weighted median	17	0.999 (0.9884-1.0096)	0.85
			Weighted mode	17	0.998 (0.9775-1.0189)	0.85

Table II. Heterogeneity tests and pleiotropy tests for instrumental variables

Exposure	**Outcome**	**Heterogeneity (IVW)**			**Pleiotropy**	
		Q	**Q_pval**		**MR-Egger Intercept**	***p*-value**
Lamb/Mutton intake	Rectal polyp	20.99	0.64		0.00015	0.42
Cereal intake		26.21	0.79		-0.00008	0.56
Non-oily fish intake		11.70	0.23		0.00027	0.45
Salad/Raw vegetable intake		16.85	0.40		-0.00014	0.64
Oily fish intake		55.25	0.43		0.00006	0.61
Frizzy drink intake		4.84	0.30		-0.00046	0.35
Beef intake		15.54	0.21		0.00076	0.04
Fresh fruit intake		53.80	0.23		-0.00001	0.96
Pork intake		17.58	0.13		0.00031	0.54
Alcohol intake frequency		112.50	0.02		-0.00007	0.46
Tea intake		23.08	0.94		-0.00007	0.29
Processed meat intake		13.04	0.84		0.00018	0.55
Poultry intake		3.16	0.79		0.00051	0.80
Cooked vegetable		9.87	0.87		0.00033	0.49

intake						

Table III. MR-PRESSO results

Exposure	Outcome	Raw			Outlier corrected		Global *p*	Number of outliers	Distortion *p*
		OR (CI %)	*p*		*OR (CI %)*	*p*			
Frizzy drink intake	Rectal polyp	1.002 (0.9939-1.0102)	0.65		NA	NA	0.362	NA	NA
Alcohol intake frequency		0.9995 (0.9975-1.0014)	0.58		NA	NA	0.007	NA	NA
Beef intake		1.0061 (0.9963-1.016)	0.24		NA	NA	0.036	NA	NA
Cereal intake		0.9991 (0.9955-1.0028)	0.64		NA	NA	0.890	NA	NA
Cooked vegetable intake		1.0014 (0.9951-1.0077)	0.67		NA	NA	0.870	NA	NA
Fresh fruit intake		1.0007 (0.995-1.0064)	0.82		NA	NA	0.244	NA	NA
Lamb/Mutton intake		0.997 (0.991-1.0031)	0.35		NA	NA	0.700	NA	NA
Non-oily fish intake		0.9925 (0.9821-1.003)	0.19		NA	NA	0.270	NA	NA
Oily fish intake		1.0007 (0.9973-1.004)	0.70		NA	NA	0.338	NA	NA
Pork intake		0.9995 (0.9879-1.0112)	0.93		NA	NA	0.142	NA	NA
Poultry intake		0.9998 (0.9903-1.0095)	0.97		NA	NA	0.588	NA	NA
Processed meat intake		0.9945 (0.9901-0.999)	0.03		NA	NA	0.862	NA	NA
Salad/Raw vegetable intake		1.0019 (0.9942-1.0096)	0.64		NA	NA	0.455	NA	NA
		0.9997 (0.997-	0.8		N	N	0.88		

Supplementary Table I. Detailed information for the GWAS data

Trait	GWAS ID	Population		SNPs
		Case/control	Descent	
Rectal polyp	ukb-b-19805	2800/460210	European	9851867
Alcohol intake frequency	ukb-b-5779	462,346	European	9,851,867
Poultry intake	ukb-b-8006	461,900	European	9,851,867
Fresh fruit intake	ukb-b-3881	446,462	European	9,851,867
Cooked vegetable intake	ukb-b-8089	448,651	European	9,851,867
Cereal intake	ukb-b-15926	441,640	European	9,851,867
Processed meat intake	ukb-b-6324	461,981	European	9,851,867
Beef intake	ukb-b-2862	461,053	European	9,851,867
Pork intake	ukb-b-5640	460,162	European	9,851,867
Non-oily fish intake	ukb-b-17627	460,880	European	9,851,867
Oily fish intake	ukb-b-2209	460,443	European	9,851,867
Salad/Raw vegetable intake	ukb-b-1996	435,435	European	9,851,867
Tea intake	ukb-b-6066	447,485	European	9,851,867
Lamb/Mutton intake	ukb-b-14179	460,006	European	9,851,867
Fizzy drink intake	ukb-b-2832	64,949	European	9,851,867

Supplementary Table II. Information for instrument variable (IV)

Exposure	**mean_F**	**min_F**	**max_F**	**Number of Total SNPs**	**Number of Unmatched SNPs**	**Number of Palindromic Structure SNPs**
Frizzy drink intake	22.96	21.22	26.27	12	7	0
Alcohol intake frequency	52.51	29.74	811.85	100	12	4
Beef intake	41.47	29.87	64.33	17	2	2
Cereal intake	45.03	30.62	125.52	43	5	4
Cooked vegetable intake	37.58	30.01	55.02	17	0	0
Fresh fruit intake	45.95	29.81	239.94	55	5	2
Lamb/Mutton intake	39.59	29.96	94.15	32	6	1
Non-oily fish intake	44.80	30.85	93.22	11	1	0
Oily fish intake	44.92	29.91	105.53	63	5	2
Pork intake	37.69	30.04	55.30	14	1	0
Poultry intake	32.54	29.85	37.13	8	0	1
Processed meat intake	38.54	29.86	77.09	23	3	0
Salad/Raw vegetable intake	38.37	29.80	73.95	23	2	4
Tea intake	60.81	30.02	493.64	41	4	1

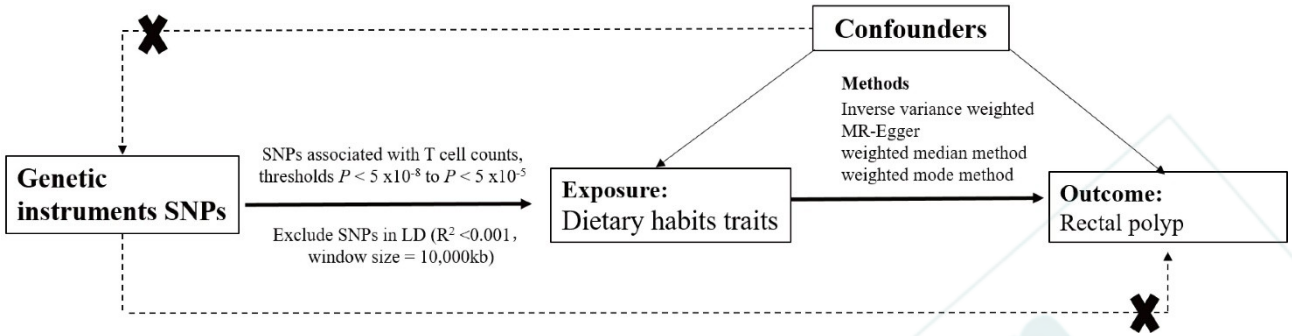

Figure 1. The flow diagram of the process in this Mendelian randomization analysis.

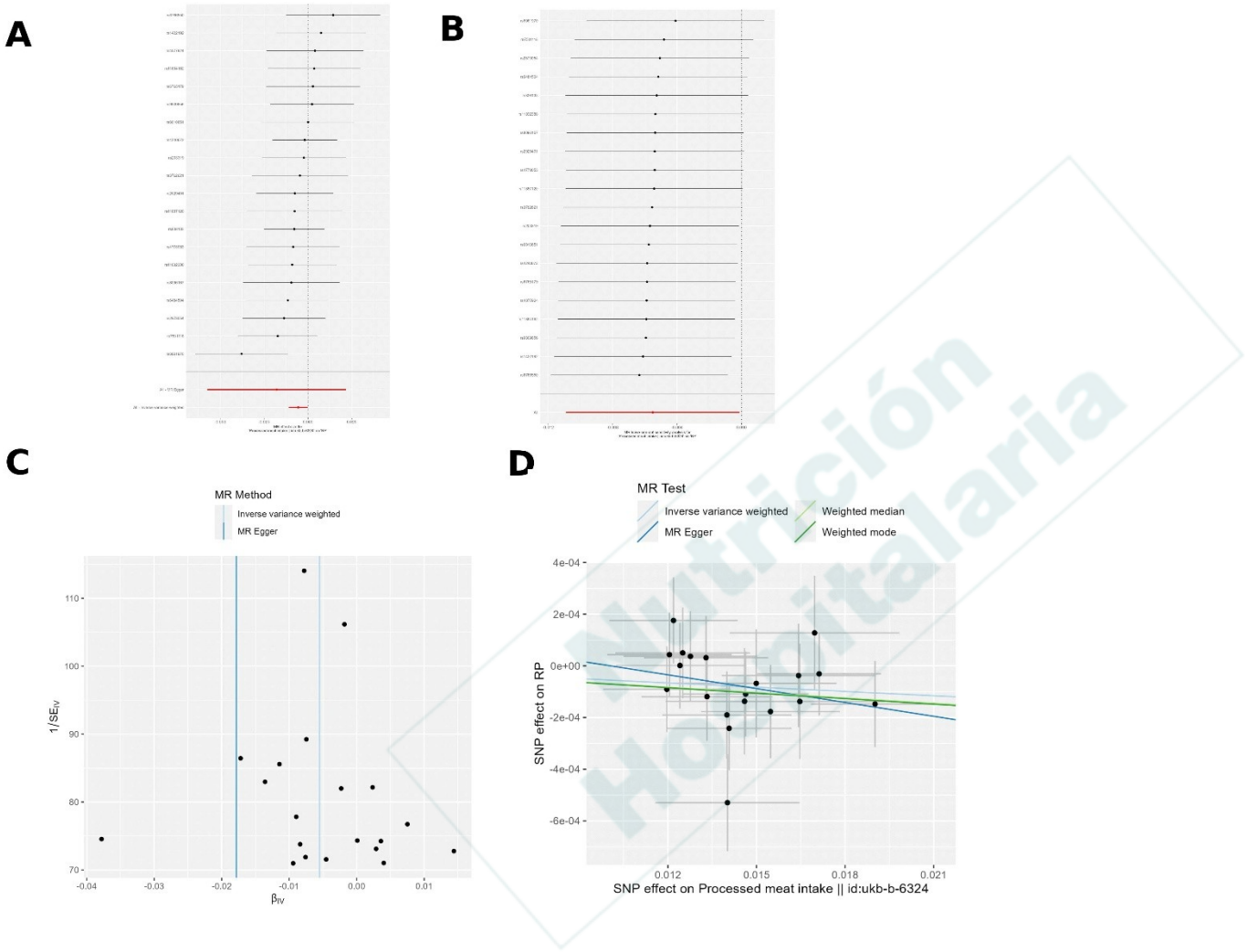

Figure 2. The association between processed meat intake and the risk of rectal polyps is presented in a forest plot (A), a leave-one-out sensitivity analysis (B), a scatter plot (C), and a funnel plot (D).

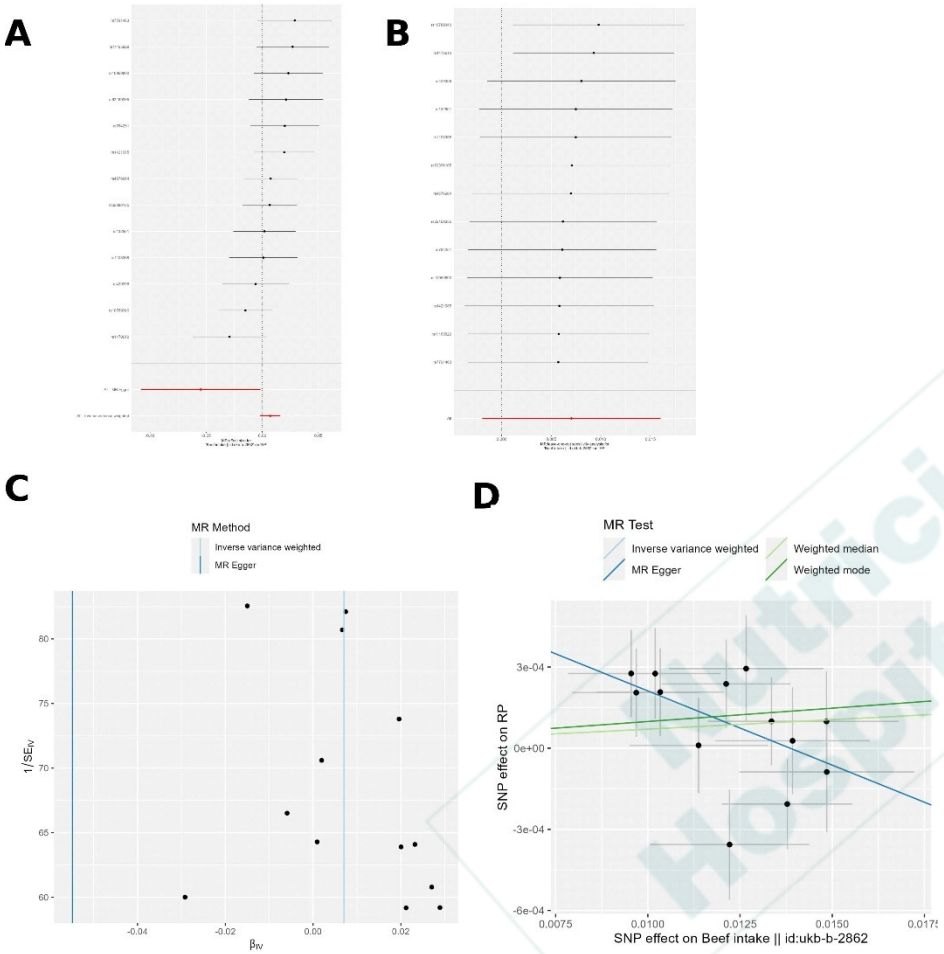

Figure 3. The association between beef intake and the risk of rectal polyps is presented in a forest plot (A), a leave-one-out sensitivity analysis (B), a scatter plot (C), and a funnel plot (D).

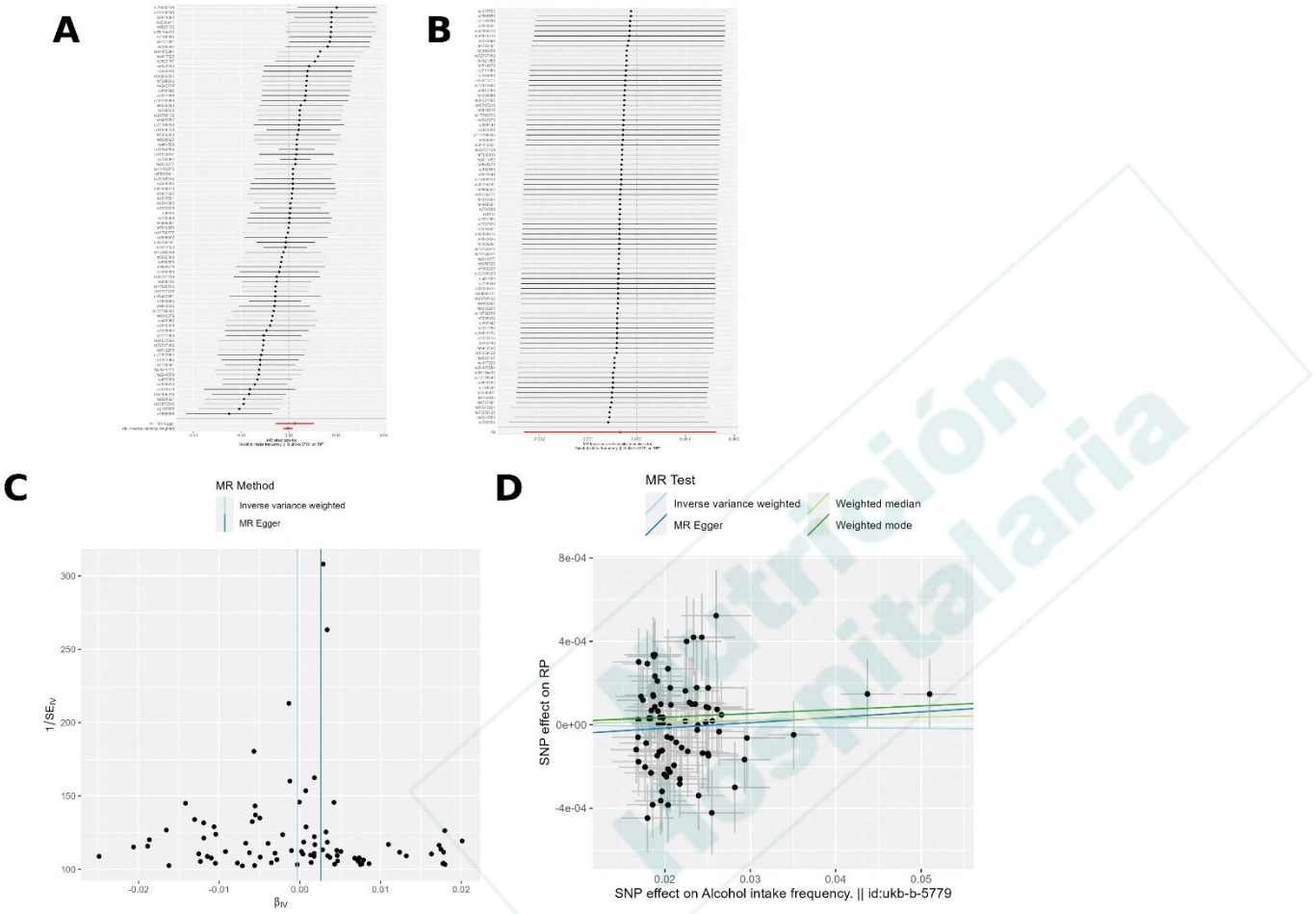

Figure 4. The association between alcohol intake frequency and risk of rectal polyps is presented in a forest plot (A), a leave-one-out sensitivity analysis (B), a scatter plot (C), and a funnel plot (D).