Causal relationship between cataracts and gastrointestinal diseases: a two-sample Mendelian randomization study

Running Title: Cataracts and gastrointestinal diseases

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Abstract

Background: Cataracts, a leading cause of blindness, have been linked to systemic conditions. Previous studies showing associations between cataracts and gastrointestinal diseases do not determine causal relationships. We aimed to investigate the causal relationship between cataracts and 23 gastrointestinal diseases.

Methods: We obtained Genome-Wide Association Study datasets for 23 gastrointestinal diseases and cataracts in European populations from the IEU OpenGWAS project. Inverse variance weighting (IVW) served as the primary method for Mendelian Randomization (MR). The heterogeneity test was analyzed by IVW and MR-Egger regression and quantified using Cochran's Q-test. Tests for multiplicity and stability were conducted using MR-Egger intercept, MR-PRESSO, and the leave-one-out method.

Results: After Bonferroni correction, four suggestive causal relationships were identified: the celiac disease was associated with increased risks of cataracts (OR = 1.012, 95% CI = 1.004-1.02, $p = 0.002$); cataracts were associated with increased risks of Crohn's disease (OR = 2.776, 95% CI = 1.055–7.302, $p = 0.039$) and pancreatic cancer (OR = 1.464, 95% CI = 1.104–1.942, $p = 0.008$); and associated with a reduced risk of duodenal ulcers (OR = 0.9988, 95% CI = 0.9977-0.9999, $p = 0.043$). Other methods showed consistent magnitude and direction. The leave-one-out method confirmed the robustness of the results.

Conclusion: These findings reveal causal effects between cataracts and gastrointestinal diseases, providing new insights into their potential biological links.

Keywords: cataract; gastrointestinal diseases; Mendelian randomization; single nucleotide polymorphism; instrumental variable

1 Introduction

Cataracts represent a significant contributor to blindness and visual impairment, characterized by clouding of the lens, and contribute to approximately 2.96% of the global population with vision impairment (65.2 million out of 2.2 billion).[1, 2] The pathogenesis of cataracts varies across different types. Age-related cataracts, the most common type, are usually associated with aging and oxidative stress.[3] Genetic factors are important risk factors for various types of cataracts, with heritability estimates varying between 35% and 58%.[4, 5] Additionally, cataracts are linked to numerous systemic diseases, including gastrointestinal diseases.[6]

Recent evidence has emphasized the crosstalk between gut health and eye health, known as the "gut-eye axis".[7] This interaction involves the microbiota, the immune system, the nervous system, and nutrient absorption.[8, 9] However, the relationship between cataracts and the gastrointestinal tract is often overlooked. An evaluation of 272,873 patients with ocular disease showed that cataracts were a more common ocular disease in patients with celiac disease, Crohn's disease, and ulcerative colitis, with prevalence rates of 12%, 22%, and 29.2%, respectively.[10] Patients with early-onset cataracts have an increased risk of peptic ulcers.[11] Furthermore, genetic associations between cataracts and gastrointestinal disorders have been observed, indicating that gene expression linked to cataracts is not confined to lens tissues.[5, 12] Specifically, gene expression in gastrointestinal tissues has shown a significant association with cataracts, with 43 of 202 Bonferroni-significant genes in the GTEx project.[12] However, the causal link between cataracts and gastrointestinal diseases is still not well understood.

Mendelian randomization (MR) analyses follow the same design principles as randomized controlled trials (RCTs) and use single nucleotide polymorphisms (SNPs) as instrumental variables

(IVs) to evaluate causality, which can reduce the bias of traditional observational studies.[13] MR provides valuable insights and evidence supporting the causal relationship between cataracts and diet,[14] lifestyle,[15] physiological factors,[16] and various diseases.[17, 18] In this research, we leveraged the genome-wide association study (GWAS) data to perform the MR analysis to determine if there is a bidirectional causal relationship between 23 gastrointestinal diseases and cataracts. Our study offers novel insights into the potential interplay between gastrointestinal diseases and cataracts.

2 Methods

2.1 Study design

We conducted bi-directional MR analyses to investigate the causality between cataracts and 23 gastrointestinal diseases. Bi-directional MR analysis is conducted to determine the causal direction between two traits (a certain gastrointestinal disorder and cataract), assessing whether one influences the other or vice versa. For accurate causal inference in MR, SNPs utilized as IVs must satisfy three principal conditions: (1) a robust association with the exposure is required; (2) they must not be linked to any confounders; (3) their effect on the outcome should be exclusive via the exposure, with no alternative routes.

2.2 Data sources

The GWAS datasets were downloaded from the IEU OpenGWAS project (https://gwas.mrcieu.ac.uk). Specific information on the GWAS datasets is presented in Table S1.

2.3 Screening of IVs

SNPs were acquired from GWAS datasets, including details such as effect allele, effect size (bata), standard error, and p value. SNPs were selected as IVs for exposure factors with a criterion of $p < 5.0\times10^{-8}$. Due to the limited number of IVs obtained for the 13 gastrointestinal diseases, there may be

insufficient statistical power. Therefore, relaxing the threshold to $p < 5\times10^{-6}$ could help capture more genetic signals and enhance statistical power while controlling for false positives.[19, 20] These diseases included esophageal cancer, duodenal ulcer, gastric ulcer, acute gastritis, chronic gastritis, Crohn's disease, diverticular disease, acute pancreatitis, chronic pancreatitis, pancreatic cancer, nonalcoholic fatty liver disease, alcoholic liver disease, and cirrhosis (Table S1).

To minimize linkage disequilibrium (LD) bias, SNPs associated with the exposure were selected with an LD threshold of $R^2 < 0.001$ and a genetic distance of 10,000 kb. The strength of the IVs was assessed using the F statistic, calculated as $F = (\beta_{exposure}/SE_{exposure})^2$. $\beta_{exposure}$ and $SE_{exposure}$ represent the effect value and standard error of the exposure dataset, respectively. $F > 10$ indicates no weak IV bias.[21]

2.4 Statistical analysis

Summary statistics from exposure and outcome datasets were harmonized to ensure that SNP effects on exposure and outcome corresponded to the same alleles. Several methods were employed in the bidirectional two-sample MR analysis, including inverse-variance weighted (IVW), MR-Egger regression, weighted median, simple mode, and weighted mode. The primary method we employed was IVW, which combines Wald ratio estimates from SNPs that satisfy the IVs assumptions, providing a consistent estimate of the causal effect of exposure on outcome. The IVW method yields the most reliable results when horizontal pleiotropy is absent.[22, 23] The weighted median method offers a consistent estimate of the causal effect when more than half of the SNPs are valid IVs.[24] MR-Egger regression, which tests for horizontal pleiotropy, could provide an unbiased causal estimate even when such pleiotropy is present.[25] The accuracy of the results is improved with the weighted median method compared to the MR-Egger method.[26] Simple mode and weighted mode analyses were conducted as supplementary analyses.[27] The Mendelian randomization of polytropic residual sums and outliers (MR-

PRESSO) test was used to identify and adjust for horizontal pleiotropy by excluding outliers.[28] The TwoSampleMR [29] and MR-PRESSO [30] packages in R were used to perform statistical analyses, with a significance threshold set at $\alpha = 0.05$ ($p < 0.05$). To address multiple testing, we applied the Bonferroni correction, factoring in the total number of exposures and outcomes.[14] A threshold of $p < 0.0022$ (0.05/23) indicated robust statistical significance, whereas results significant at $p = 0.0022$-0.05 after correction were classified as potential associations.

2.5 Heterogeneity and sensitivity test

IVW and MR-Egger regression were used for heterogeneity tests among IVs. The heterogeneity was quantified using Cochran's Q-test. When the $p < 0.05$, it implies the presence of heterogeneity, so the random effects IVW model is employed. The leave-one-out method was employed to determine whether any single SNP had a significant impact on the MR results.

3 Results

3.1 Causal effects of gastrointestinal diseases on cataracts

Gastrointestinal diseases were the exposure factors, and cataract was the outcome variable. Following the selection of SNPs based on the aforementioned criteria, we excluded palindromic SNPs (A/T or G/C) and those unavailable in the outcome data. Consequently, we identified between 4 to 66 SNPs as IVs for 23 gastrointestinal diseases. The F-statistics for all identified IVs exceeded 10.

MR analyses support the causal links between genetic susceptibility to gastroesophageal reflux disease (GERD) and celiac disease and an increased risk of cataracts. The IVW model showed a significant association between GERD and cataracts (OR = 1.131, 95% CI = 1.065-1.201, $p = 5.85E-05$), as well as between celiac disease and cataracts (OR = 1.012, 95% CI = 1.004-1.02, $p = 0.0023$) (Figure 1, Table S2). The intercepts of the MR-Egger regression were near 0, suggesting no horizontal

pleiotropy of IVs in gastrointestinal diseases and indicating a negligible likelihood of affecting the MR results (Table S3).

Both MR-Egger and IVW analyses for GERD and celiac disease showed no heterogeneity (Table S4). However, heterogeneity was found between nine gastrointestinal diseases and cataracts (Table S4). Therefore, random effects IVW and MR-PRESSO tests were applied, which indicated no causal effect between these diseases and cataract risk (Table S5). The results of the leave-one-out method indicated that the causal effect between GERD and celiac disease and an increased risk of cataracts was robust and not influenced by any single SNP (Figure 2A-B). Nevertheless, this result should be interpreted with caution due to the inconsistent direction of MR-Egger compared to other MR analysis methods for GERD (Figure 2C-D).

3.2 Causal effects of cataracts on gastrointestinal diseases

Cataract was the exposure factor, and gastrointestinal diseases was the outcome variable. We identified between 3 to 25 SNPs as IVs for cataracts. All identified IVs had F-statistics exceeding 10.

MR analyses revealed cataracts were linked to a heightened risk of Crohn's disease (IVW result, OR = 2.776, 95% CI = 1.055–7.302, $p = 0.039$) and pancreatic cancer (IVW result, OR = 1.464, 95% CI = 1.104–1.942, $p = 0.008$) (Figure 3, Table S6). Meanwhile, cataracts were related to the risk of duodenal ulcers (IVW results: OR = 0.9988, 95% CI = 0.9977-0.9999, $p = 0.043$). Furthermore, there was no horizontal pleiotropy of IVs (Table S7). However, heterogeneity was found between cataracts and six gastrointestinal diseases (Table S8). Subsequently, random effects IVW and MR-PRESSO tests were applied, which indicated no causal effect between cataracts and the risks of these diseases (Table S5). The leave-one-out method indicated the robustness of the MR analysis results (Figure 4). Notably, Bonferroni correction ($p < 0.0022$) suggested that these casual relationships were suggestive.

4 Discussion

Gastrointestinal diseases often present with extraintestinal manifestations, including various ocular features.[31] Cataracts, a common ocular condition, are frequently associated with systemic diseases.[6] In this study, we identified the suggestive causal relationship between cataracts and 4 gastrointestinal diseases, providing genetic evidence for their association.

GERD may affect organs adjacent or distant to the esophagus because they lack protective mechanisms similar to those of the esophagus.[32] A retrospective analysis found that up to 19% of patients undergoing cataract surgery under local anesthesia also had GERD.[33] In addition, a prospective cohort study evaluated the relationship between GERD and its comorbidities and the incidence of cataracts during a one-year follow-up period.[34] The results showed that various manifestations of GERD, including Barrett's esophagus, esophagitis, and simple reflux (hazard ratio [HR], 1.40; 95%CI, 1.08-1.81) were associated with an increased risk of cataracts. These observational studies frequently face limitations due to confounding factors and reverse causality, which bias causal inferences.[35] While we found that a potential association between GERD and cataracts (IVW model), inconsistencies across MR methods highlight the need for further validation through prospective studies.

Celiac disease is an autoimmune disease of the small intestine. Previous cases have reported bilateral cataracts as a presenting feature of celiac disease.[36] In a cohort study of 28,756 patients with biopsy-proven celiac disease, there was an increased risk of cataracts (HR = 1.8, 95% CI: 1.19, 1.36), This association may be related to immune response, nutrient absorption, and oxidative stress.[37] Our MR analysis supports this association, which is consistent with previous research.[38] Celiac disease patients often exhibit reduced antioxidant capacity, which can lead to oxidative stress,[39] thereby exacerbating glutathione depletion and lipid peroxidation in the crystalline lens.[40] Dysbiosis in the gut

169 microbiome may also contribute,[41] as intestinal metabolites such as tauroursodeoxycholic acid have
170 been shown to effectively reduce the apoptosis of lens epithelial cells [42]. Furthermore, chronic
171 malabsorption in celiac disease can lead to deficiencies in zinc, selenium, and vitamins C and E, all of
172 which are critical for lens health [43] The use of systemic corticosteroids requires caution in patients with
173 celiac disease, as prolonged use may lead to posterior subcapsular cataract formation.[44]

174 Crohn's disease is a long-term inflammatory lesion affecting the gastrointestinal tract that may be
175 associated with ocular manifestations such as cataracts.[45] Whole exome sequencing of individuals with
176 congenital cataracts, retinitis pigmentosa, and Crohn's disease identified pathogenic variants, Wolfram
177 Syndrome 1 (WFS1), Nucleotide-binding Oligomerization Domain-containing Protein 2 (NOD2), and
178 Retinitis Pigmentosa 1 (RP1) genes, which are implicated in calcium regulation.[46] Of these, the NOD2
179 gene is aberrantly expressed in ocular tissues under pathological conditions, including cataracts.[47]
180 Variations in NOD2 can lead to defects in intestinal flora and the innate immune response, causing
181 Crohn's disease.[48] Furthermore, glutathione peroxidase 1 (GPX1) is involved in maintaining oxidative
182 homeostasis and lens transparency in lens cells,[49] and the rs1800668 polymorphism of GPX1 is related
183 to an elevated risk of Crohn's disease in New Zealand population.[50] These findings support our result,
184 suggesting the relationship between genetically predicted cataracts and the risk of Crohn’s disease. This
185 association may be driven by the interplay between genetic factors and biological pathways,
186 particularly calcium homeostasis and oxidative stress homeostasis.

187 Optic nerve involvement and vision loss may result from pancreatic cancer metastasis to the
188 choroid and other structures of the eye.[51] The causal relationship between cataracts and pancreatic
189 cancer may be due to common genetic factors and metabolic pathways. Breast cancer type 2 $(BRCA2)^{-/-}$
190 mice exhibit mammary gland hypoplasia, cataract formation, and increased susceptibility to several

cancers, including pancreatic cancer.[52] Aberrant retinoic acid signaling, critical for both pancreatic and lens development, may also provide a mechanistic link.[53, 54] For example, cellular retinoic acid-binding protein, regulating intracellular retinoic acid concentration, has been implicated in both cataract formation and pancreatic cancer progression.[55]

Duodenal ulcers result from disruptions in mucosal integrity in the proximal small intestine, with Helicobacter pylori, smoking, and genetic susceptibility as risk factors.[56] Our results revealed the associations between cataracts with a reduced risk of duodenal ulcers. This contrasts with a retrospective cohort study from Taiwan that reported a higher overall incidence of peptic ulcers in patients with early-onset cataracts (n = 1910).[11] Such discrepancies may arise from the limitations of observational or heterogeneity among different populations, including genetic polymorphisms and environmental factors (such as diet). There are fewer studies on the association between these two diseases, and more prospective studies are needed.

Our study identified four genetic associations between cataracts and gastrointestinal diseases, including novel causal relationships with Crohn's disease, pancreatic cancer, and duodenal ulcers. We summarized potential mechanisms underlying these associations, which may involve shared and specific biological pathways. These include the interplay between genetic and disease pathways related to oxidative stress, inflammation, gut microbial metabolites, and calcium homeostasis—factors that could serve as bridges between gut and lens health. While these findings provide valuable insights, further cohort studies and functional experiments are needed to establish causal links and elucidate precise mechanisms.

This study has several limitations. Although the confounding factors and statistical efficiency of the two-sample MR analysis were good, inconsistencies in the quality and source of the data may

introduce systematic bias. Furthermore, the study was limited to a European population, which affects the applicability of the results to other populations. Different ethnic groups may have distinct genetic backgrounds and environmental exposures, which could influence the observed associations. Additionally, although relaxing the SNP selection threshold to $p < 5\times10^{-6}$ is a result of balancing statistical bias and power, it may still lead to the introduction of potentially non-informative tools and increase the risk of pleiotropy, which could bias the results. Although we tested for pleiotropy, it is challenging to completely rule it out.

5 Conclusion

Our study is the first to examine the causal links between cataracts and gastrointestinal diseases using MR. The findings provide genetic evidence for potential associations between celiac disease and increased cataract risk, cataracts and increased risks of Crohn's disease and pancreatic cancer, and a decreased risk of duodenal ulcers. Further research, especially with more homogenous populations and prospective studies, are necessary to confirm these associations and clarify the underlying mechanisms.

Declarations

Ethics approval and consent to participate

Not Applicable.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Yanchun Li: Conceptualization, Data curation, Investigation, Methodology, Writing—original draft. QingMin Pan: Investigation, Methodology, Validation, Visualization, Formal analysis. MengYa Wang: Methodology, Software, Validation, Formal analysis. Bin Zhao: Conceptualization, Data curation, Methodology, Resources, Writing—original draft.

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Competing interests

The author(s) declare no competing interests.

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Figure legends

Figure 1. Forest plots of the causal effect of 23 gastrointestinal diseases on cataracts (IVW method results).

Figure 2. The causal effect of gastrointestinal diseases on cataracts. (A) Leave-one-out plots. (B) Scatter plots. Gastroesophageal reflux disease (left). Celiac disease (right).

Figure 3. Forest plots of the causal effect of cataracts on 23 gastrointestinal diseases (IVW method results).

Figure 4. The causal effect of cataracts on gastrointestinal diseases. (A) Leave-one-out plots. (B) Scatter plots. Crohn's disease (left). Pancreatic cancer (middle). Duodenal ulcers (right).

Figure 1

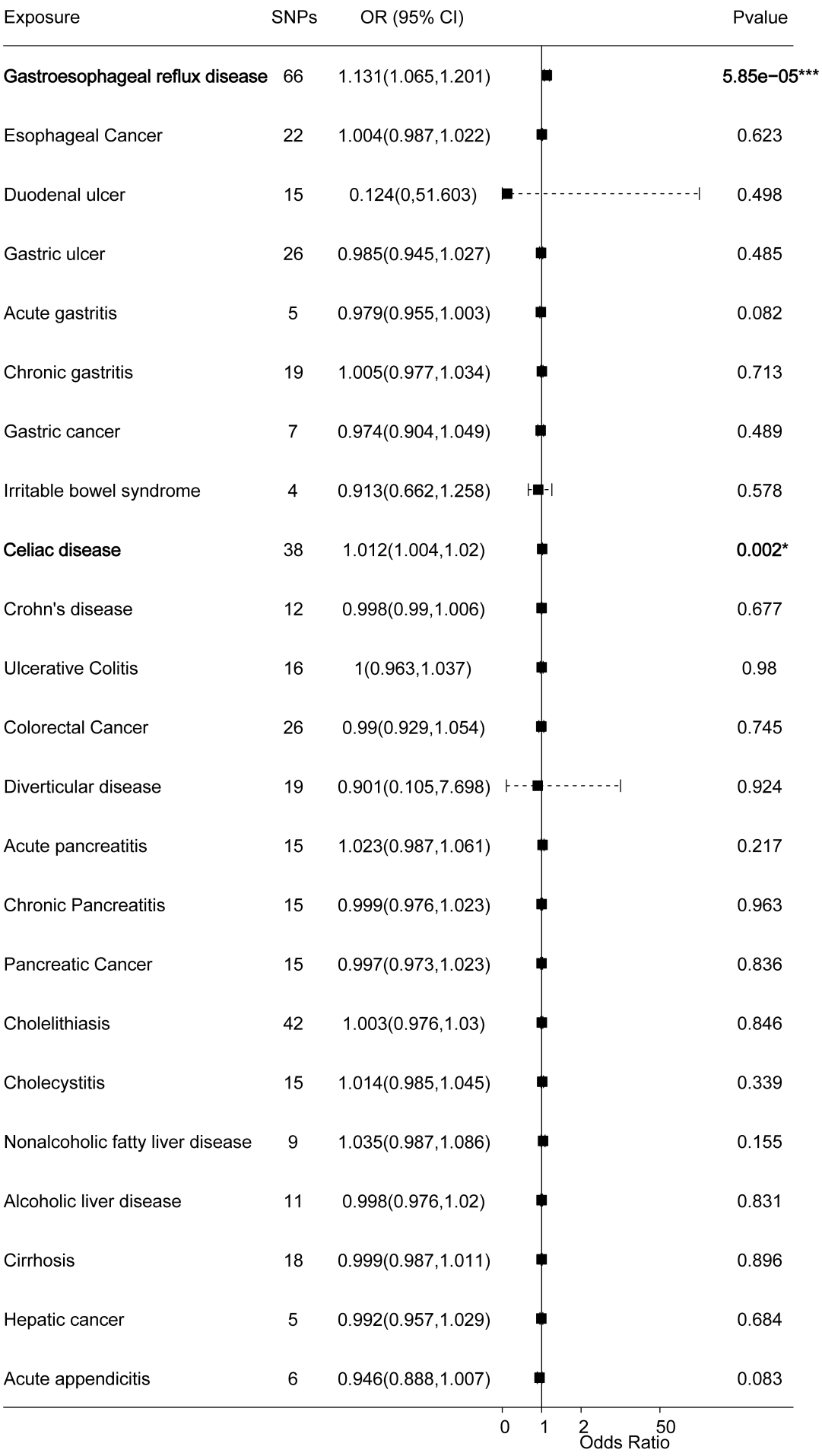
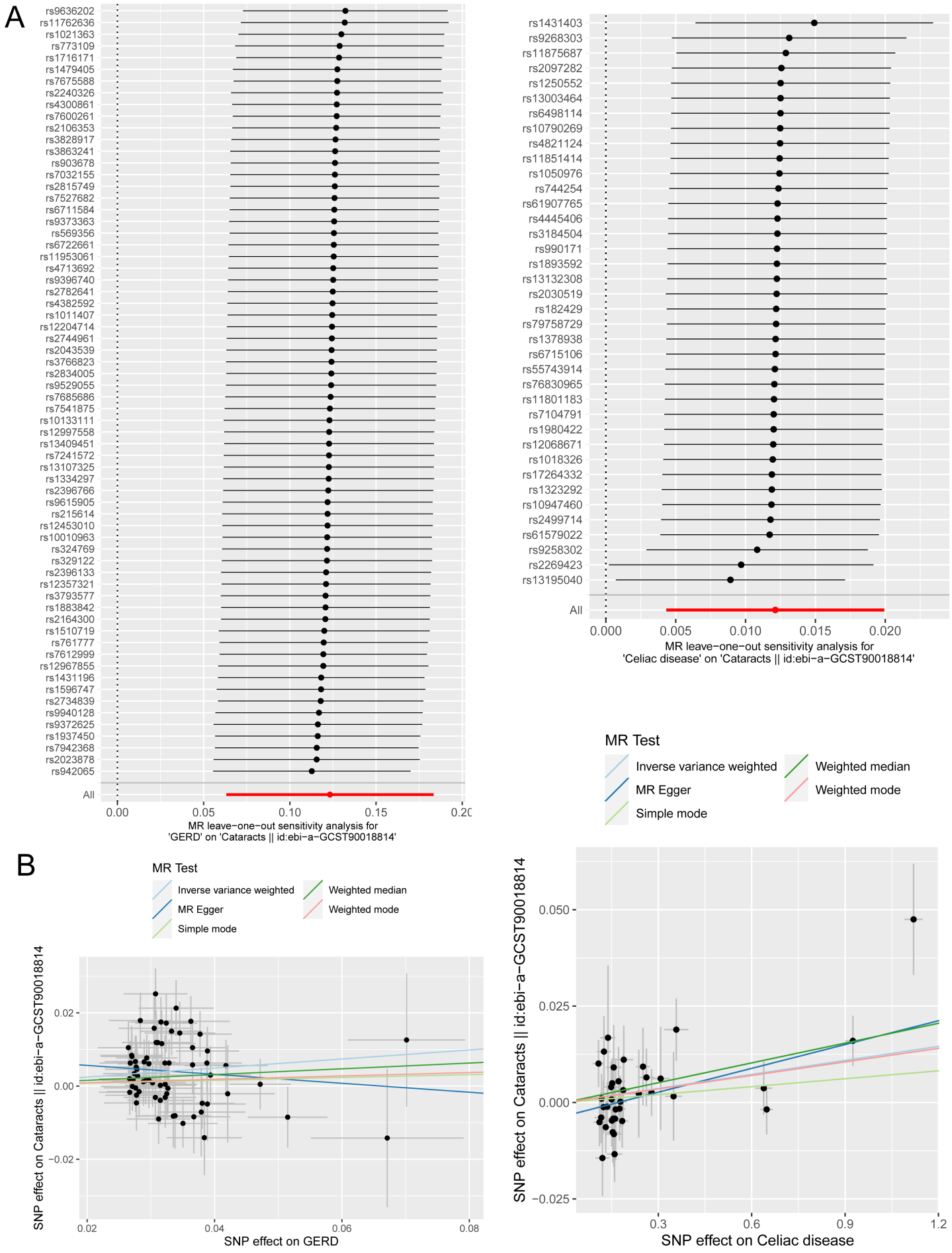

Exposure
SNPs
OR (95% CI)
Pvalue
Gastroesophageal reflux disease 66 1.131(1.065,1.201) 5.85e−05***
Esophageal Cancer 22 1.004(0.987,1.022) 0.623
Duodenal ulcer 15 0.124(0,51.603) 0.498
Gastric ulcer 26 0.985(0.945,1.027) 0.485
Acute gastritis 5 0.979(0.955,1.003) 0.082
Chronic gastritis 19 1.005(0.977,1.034) 0.713
Gastric cancer 7 0.974(0.904,1.049) 0.489
Irritable bowel syndrome 4 0.913(0.662,1.258) 0.578
Celiac disease 38 1.012(1.004,1.02) 0.002*
Crohn's disease 12 0.998(0.99,1.006) 0.677
Ulcerative Colitis 16 1(0.963,1.037) 0.98
Colorectal Cancer 26 0.99(0.929,1.054) 0.745
Diverticular disease 19 0.901(0.105,7.698) 0.924
Acute pancreatitis 15 1.023(0.987,1.061) 0.217
Chronic Pancreatitis 15 0.999(0.976,1.023) 0.963
Pancreatic Cancer 15 0.997(0.973,1.023) 0.836
Cholelithiasis 42 1.003(0.976,1.03) 0.846
Cholecystitis 15 1.014(0.985,1.045) 0.339
Nonalcoholic fatty liver disease 9 1.035(0.987,1.086) 0.155
Alcoholic liver disease 11 0.998(0.976,1.02) 0.831
Cirrhosis 18 0.999(0.987,1.011) 0.896
Hepatic cancer 5 0.992(0.957,1.029) 0.684
Acute appendicitis 6 0.946(0.888,1.007) 0.083
0
1
2
50
Odds Ratio

Figure 2


A
rs9636202
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rs773109
rs1716171
rs1479405
rs7675588
rs2240326
rs4300861
rs7600261
rs2106353
rs3828917
rs3863241
rs903678
rs7032155
rs2815749
rs7527682
rs6711584
rs9373363
rs569356
rs6722661
rs11953061
rs4713692
rs9396740
rs2782641
rs4382592
rs1011407
rs12204714
rs2744961
rs2043539
rs3766823
rs2834005
rs9529055
rs7685686
rs7541875
rs10133111
rs12997558
rs13409451
rs7241572
rs13107325
rs1334297
rs2396766
rs9615905
rs215614
rs12453010
rs10010963
rs324769
rs329122
rs2396133
rs12357321
rs3793577
rs1883842
rs2164300
rs1510719
rs761777
rs7612999
rs12967855
rs1431196
rs1596747
rs2734839
rs9940128
rs9372625
rs1937450
rs7942368
rs2023878
rs942065
All
0.00
0.05
0.10
0.15
0.20
MR leave−one−out sensitivity analysis for
'GERD' on 'Cataracts || id:ebi−a−GCST90018814'
rs1431403
rs9268303
rs11875687
rs2097282
rs1250552
rs13003464
rs6498114
rs10790269
rs4821124
rs11851414
rs1050976
rs744254
rs61907765
rs4445406
rs3184504
rs990171
rs1893592
rs13132308
rs2030519
rs182429
rs79758729
rs1378938
rs6715106
rs55743914
rs76830965
rs11801183
rs7104791
rs1980422
rs12068671
rs1018326
rs17264332
rs1323292
rs10947460
rs2499714
rs61579022
rs9258302
rs2269423
rs13195040
All
0.000
0.005
0.010
0.015
0.020
MR leave−one−out sensitivity analysis for
'Celiac disease' on 'Cataracts || id:ebi−a−GCST90018814'
MR Test
Inverse variance weighted
MR Egger
Simple mode
Weighted median
Weighted mode
B
MR Test
Inverse variance weighted
MR Egger
Simple mode
Weighted median
Weighted mode
SNP effect on Cataracts || id:ebi−a−GCST90018814
0.02
0.00
−0.02
0.02
0.04
0.06
0.08
SNP effect on GERD
SNP effect on Cataracts || id:ebi−a−GCST90018814
0.050
0.025
0.000
−0.025
0.3
0.6
0.9
1.2
SNP effect on Celiac disease

Figure 3

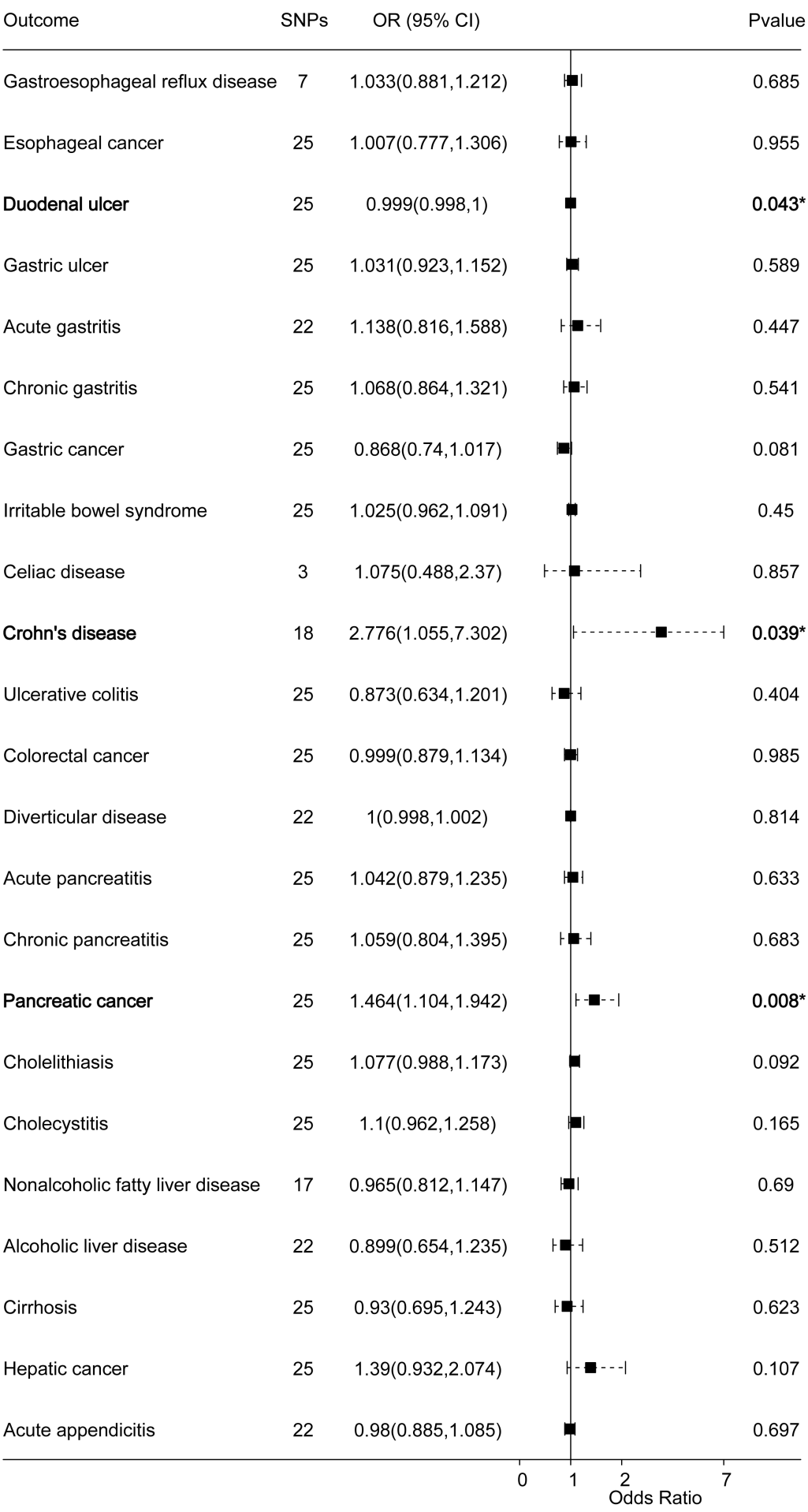
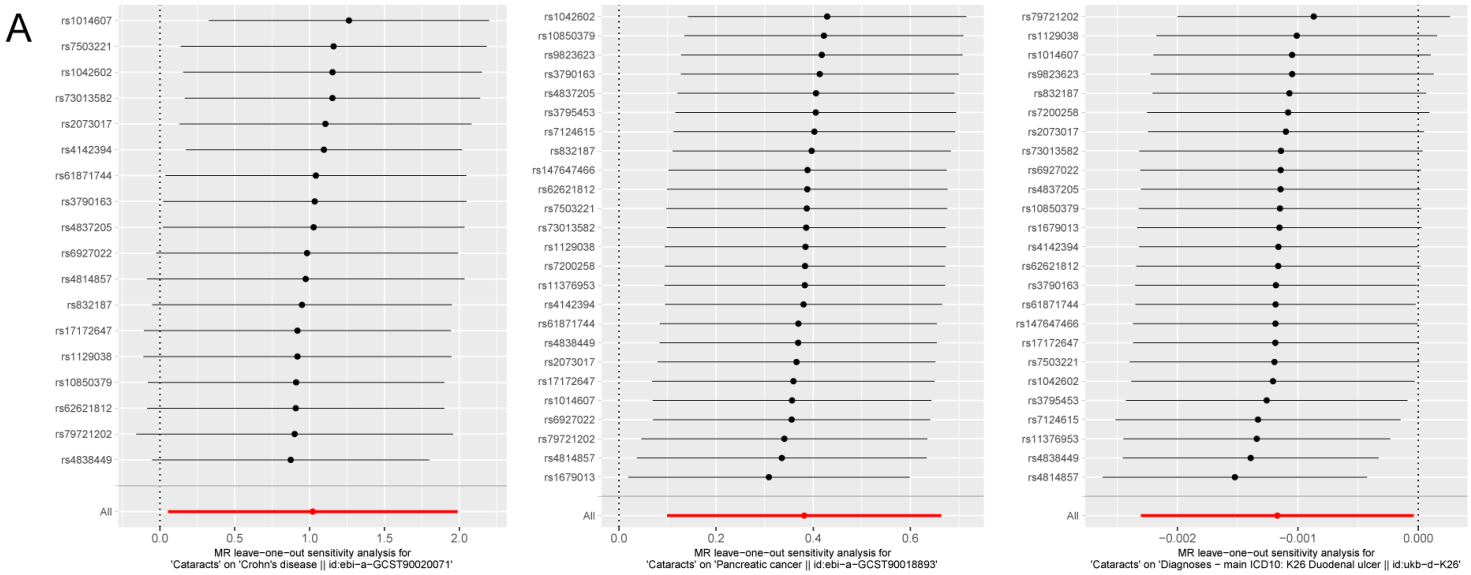

Outcome
SNPs
OR (95% CI)
Pvalue
Gastroesophageal reflux disease 7 1.033(0.881,1.212) 0.685
Esophageal cancer 25 1.007(0.777,1.306) 0.955
Duodenal ulcer 25 0.999(0.998,1) 0.043*
Gastric ulcer 25 1.031(0.923,1.152) 0.589
Acute gastritis 22 1.138(0.816,1.588) 0.447
Chronic gastritis 25 1.068(0.864,1.321) 0.541
Gastric cancer 25 0.868(0.74,1.017) 0.081
Irritable bowel syndrome 25 1.025(0.962,1.091) 0.45
Celiac disease 3 1.075(0.488,2.37) 0.857
Crohn's disease 18 2.776(1.055,7.302) 0.039*
Ulcerative colitis 25 0.873(0.634,1.201) 0.404
Colorectal cancer 25 0.999(0.879,1.134) 0.985
Diverticular disease 22 1(0.998,1.002) 0.814
Acute pancreatitis 25 1.042(0.879,1.235) 0.633
Chronic pancreatitis 25 1.059(0.804,1.395) 0.683
Pancreatic cancer 25 1.464(1.104,1.942) 0.008*
Cholelithiasis 25 1.077(0.988,1.173) 0.092
Cholecystitis 25 1.1(0.962,1.258) 0.165
Nonalcoholic fatty liver disease 17 0.965(0.812,1.147) 0.69
Alcoholic liver disease 22 0.899(0.654,1.235) 0.512
Cirrhosis 25 0.93(0.695,1.243) 0.623
Hepatic cancer 25 1.39(0.932,2.074) 0.107
Acute appendicitis 22 0.98(0.885,1.085) 0.697
0
1
2
7
Odds Ratio

Figure 4


A
rs1014607
rs7503221
rs1042602
rs73013582
rs2073017
rs4142394
rs61871744
rs3790163
rs4837205
rs6927022
rs4814857
rs832187
rs17172647
rs1129038
rs10850379
rs62621812
rs79721202
rs4838449
All
0.0
0.5
1.0
1.5
2.0
MR leave−one−out sensitivity analysis for
'Cataracts' on 'Crohn's disease || id:ebi−a−GCST90020071'
rs1042602
rs10850379
rs9823623
rs3790163
rs4837205
rs3795453
rs7124615
rs832187
rs147647466
rs62621812
rs7503221
rs73013582
rs1129038
rs7200258
rs11376953
rs4142394
rs61871744
rs4838449
rs2073017
rs17172647
rs1014607
rs6927022
rs79721202
rs4814857
rs1679013
All
0.0
0.2
0.4
0.6
MR leave−one−out sensitivity analysis for
'Cataracts' on 'Pancreatic cancer || id:ebi−a−GCST90018893'
rs79721202
rs1129038
rs1014607
rs9823623
rs832187
rs7200258
rs2073017
rs73013582
rs6927022
rs4837205
rs10850379
rs1679013
rs4142394
rs62621812
rs3790163
rs61871744
rs147647466
rs17172647
rs7503221
rs1042602
rs3795453
rs7124615
rs11376953
rs4838449
rs4814857
All
−0.002
−0.001
0.000
MR leave−one−out sensitivity analysis for
'Cataracts' on 'Diagnoses − main ICD10: K26 Duodenal ulcer || id:ukb−d−K26'
B
MR Test
Inverse variance weighted
MR Egger
Simple mode
Weighted median
Weighted mode
SNP effect on Crohn's disease || id:ebi−a−GCST90020071
1.0
0.5
0.0
−0.5
0.05
0.10
0.15
0.20
SNP effect on Cataracts
MR Test
Inverse variance weighted
MR Egger
Simple mode
Weighted median
Weighted mode
SNP effect on Pancreatic cancer || id:ebi−a−GCST90018893
0.1
0.0
−0.1
0.05
0.10
0.15
0.20
SNP effect on Cataracts
MR Test
Inverse variance weighted
MR Egger
Simple mode
Weighted median
Weighted mode
effect on Diagnoses − main ICD10: K26 Duodenal ulcer || id:ukb−d−K26
5e−04
0e+00
−5e−04
0.05
0.10
0.15
0.20
SNP effect on Cataracts