Supplementary Online Content

Dhanasekara CS, Ancona D, Cortes L, et al. Association between autism spectrum disorders and cardiometabolic diseases: a systematic review and meta-analysis. *JAMA Pediatr*. Published online January 30, 2023. doi:10.1001/jamapediatrics.2022.5629

eTable 1. PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	6
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Figure 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	6, eTable 3
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to	7

		collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	6-7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	7-8
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	7
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	7-8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	7-8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	7-8
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	6-8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of	8

		evidence for an outcome.	
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	8, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	eTable 9
Study characteristics	17	Cite each included study and present its characteristics.	eTable 4
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	eTable 4
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	8-11 Figure 2-5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	8-11
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	8-11
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	9-11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	8-11
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	eFigure 1
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	8-11
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	11-13
	23b	Discuss any limitations of the evidence included in the review.	13-14
	23c	Discuss any limitations of the review	13-14

		processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	6
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	15
Competing interests	26	Declare any competing interests of review authors.	15
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

eTable 2. MOOSE Checklist

REPORTING CRITERIA	Reported	Page No.
Reporting of Background		
Problem definition	Yes	5
Hypothesis statement	Yes	6
Description of study outcomes(s)	Yes	6
Type of exposure or intervention used	Yes	6
Type of study design used	Yes	6
Study population	Yes	6
Reporting of Search Strategy		
Qualifications of searchers (librarians & investigators)	Yes	7
Search strategy including time period included in synthesis and keywords	Yes	7, eTable 3
Effort to include all available studies including contact with authors	Yes	7
Database and registries searched	Yes	6
Search software used, name and version, including special features used	Yes	N/A
Use of hand searching (e.g. reference list of obtained articles)	Yes	eTable 9
List of citations located and those excluded, including justification	Yes	Figure 1, eTable 9
Method for addressing articles published in languages other than English	Yes	6
Method of handling abstracts and unpublished studies	Yes	6
Description of any contact with authors	Yes	7
Reporting of Methods		
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Yes	eTable 4
Rationale for the selection and coding of data (e.g., sound clinical principles or convenience)	Yes	6-7
Documentation of how data were classified and coded (e.g., multiple raters, blinding, and interrater reliability)	Yes	6-7
Assessment of confounding (e.g., comparability of cases and controls in studies where appropriate)	Yes	eTable 5
Reporting Criteria		
Assessment of study quality, including blinding of quality assessors; stratification or regression of possible predictors of study results	Yes	eTable 4
Assessment of heterogeneity	Yes	7-8
Description of statistical methods (e.g., complete description of fixed or random effects models, justification of whether chosen models account for predictors of study results, dose response models or cumulative meta-analysis) in sufficient detail to be replicated	Yes	7-8
Provision of appropriate tables or graphs	Yes	eTable 4, Figure 1
Reporting of Results		
Table giving descriptive information for each study included	Yes	eTable 4
Results of sensitivity testing (e.g., subgroup analysis)	Yes	8-11
Indication of statistical uncertainty of findings	Yes	8-11
Reporting of Discussion		
Quantitative assessment of bias	Yes	8-11
Justification of exclusion	Yes	Figure 1
Assessment of quality of included studies	Yes	eTable 4
Reporting of Conclusions		
Consideration of alternative explanations for observed results	Yes	12-14
Generalisation of conclusions	Yes	12-14
Guidelines for future research	Yes	14
Disclosure of funding source	Yes	15

eTable 3. Keywords and Keyword Combinations Used to Screen the PubMed, Scopus, Web of Science, ProQuest, Embase, and Ovid Electronic Databases

("hyperglycemia" OR "insulin" OR “glucose” OR “sugar” OR "diabetes" OR “HbA1c” OR “glycosylated hemoglobin” OR “HOMA-IR” OR “hypertension” OR “blood pressure” OR "dyslipidemia" OR “hyperlipidemia” OR “hypercholesterolemia” OR “hyperlipoproteinemia” OR “Hypertriglyceridemia” OR “cholesterol” OR “triglyceride” OR “LDL” OR “VLDL” OR “HDL” OR "waist circumference” OR “abdominal obesity” OR “central obesity" OR “coronary artery disease” OR “coronary artery diseases” OR “ischemic heart disease” OR “ischemic heart diseases” OR “myocardial ischemia” OR “myocardial infarction” OR “acute coronary syndrome” OR “acute coronary syndromes” OR “cerebrovascular accident” OR “cerebrovascular accidents” OR “stroke” OR “strokes” OR “brain vascular accident” OR “brain vascular accidents” OR “peripheral vascular disease” OR “peripheral vascular diseases” OR “limb ischemia” OR “intermittent claudication” OR “intermittent claudications” OR “non alcoholic fatty liver” OR “non-alcoholic fatty liver” OR “nonalcoholic fatty liver” OR “non alcoholic steatohepatitis” OR “non-alcoholic steatohepatitis” OR “nonalcoholic steatohepatitis” OR “polycystic ovarian syndrome” OR “polycystic ovary syndrome” OR “polycystic ovaries” OR “Stein-Leventhal” OR “Stein Leventhal” OR “Sclerocystic Ovary” OR “Sclerocystic Ovarian”)

AND

(“pervasive developmental”[Title/Abstract] OR “pervasive child development” [Title/Abstract] OR “autism” [Title/Abstract] OR “asperger syndrome” [Title/Abstract] OR “autistic” [Title/Abstract])

NOT

("maternal"[Title] OR "gestation"[Title] OR "gestational"[Title] OR "pregnant"[Title] OR "pregnancy"[Title] OR "prenatal"[Title] OR “pre-natal”[Title] OR "offspring"[Title] OR “mothers”[Title] OR “children of”[Title] OR “infants of”[Title] OR “babies of”[Title] OR “toddlers of”[Title])

eTable 4. Characteristics of the Studies Meeting Eligibility for the Systematic Review and Primary Meta-analyses

Study (year)	Database/ source of patients	Type of study (rating)[a]	Diagnosis of disease	Group (children %), region	Female (%), age (mean [range]), non-Caucasians (%), obesity (%)	Disease / laboratory parameters	Autism	Control	Quality (Good, Fair, or Poor)
Studies reporting statistics that could be used to compute the relative risk of cardiometabolic disease in autism									
Akobirshoev et al. (2020)[1]	Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 2004–2014	Retrospective cohort study (3)	Registers	Adults, US	31, [18-55+], 35.3, NA	DM-NS, HT, PVD	462	967	Fair
Alabaf et al. (2020)[2]	Child and Adolescent Twin Study, 1992–2006	Retrospective cohort study (3)	Self-report	Children, Sweden	34.2, 9.7 (either 9 or 12 years), NA, NA	T1DM	301	22028	Poor
Brooks et al. (2021)[3]	Electronic Medical Record Primary Care database	Retrospective cohort study (3)	Registers	Both[b], Canada	21.7, 12.6 [1-24], NA, NA	DM-NS	1062	79175	Good
Chen et al. (2009)[4]	National Health Insurance Research Database, 1997–2004	Retrospective cohort study (3)	Registers	Children, Taiwan	18.4, 3.8[c], 100, NA	DM-NS	3440	34391	Good
Chen et al. (2013)[5]	National Health Insurance Research Databases, 1996–2010	Retrospective cohort study (3)	Registers	Both[b], Taiwan	20.3, 17.5[c], 100, NA	T1DM	1598	6392	Good
Chen et al. (2016)[6]	National Health Insurance Research Databases, 2002–2009	Retrospective cohort study (3)	Registers	Both (79.1), Taiwan	20, 15.3[c], 100, NA	T2DM, HT, DL	6122	24488	Good
Croen et al. (2015)[7]	Kaiser Permanente in Northern California, 2008–2012	Retrospective cohort study (3)	Registers	Adults, US	26.9, 29 [18-65+], 34.4, 2.7	DM-NS, HT, DL, stroke	1507	15070	Good
Davignon et al. (2018)[8]	Kaiser Permanente in Northern California, 2013–2015	Retrospective cohort study (3)	Registers	Both (45.7), US	19.3, 18.4 [14-25], 46.45, 33.91	DM-NS, DL	4123	20615	Good
Gurney et al. (2006)[9]	National Survey of Children's Health, 2003-2004	Retrospective cohort study (3)	Parent-report	Children, US	21, 9.3 [3-17], 26.1, 25.2	DM-NS	483	84789	Fair

Hand et al. (2020)[10]	Medicare Standard Analytic Files, 2016-2017	Retrospective cohort study (3)	Registers	Adults, US	32.2, 71.3 [65-84+], 11.1, NA	DM-NS, HT, DL, stroke, heart disease	4685	46850	Good
Kohane et al. (2012)[11]	Health Research Informatics Network system, 2001-2010	Retrospective cohort study (3)	Registers	Both (63.3), US	20.7, <35[c], NA	T1DM	14381	2,379,397	Fair
Mouridsen et al. (2016)[12]	Nationwide Danish National Hospital Register, 1960-1984	Retrospective cohort study (3)	Registers	Adults, Denmark	28, 49.6[c], NA, NA	HT, stroke	118	336	Fair
Nugent et al. (2022)[13]	National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey, (2002-2018)	Retrospective cohort study (3)	Registers	Children, US	19.2, 11.67 [6-18], NA, 4.8	HT	119	33525	Good
Schott et al. (2021)[14]	Medicaid Analytic eXtract data, 2008-2012	Retrospective cohort study (3)	Registers	Adults, US	25.9, 28.5 [18-64], 37.34, NA	DM-NS, HT, DL, stroke	155617	466851	Fair
Shedlock et al. (2016)[15]	Military Health System database, 2000-2013	Retrospective cohort study (3)	Registers	Children, US	20, 8.8 [2-18], NA, 9.86	T2DM, HT, DL	48762	243810	Good
Supekar et al. (2017)[16]	Stanford Translational Research Integrated Database Environment, 1995-1999	Retrospective cohort study (3)	Registers	Both[b], US	56, [0-35+], 65, NA	T1DM	4790	1842575	Good
Tyler et al. (2012)[17]	Cleveland Clinic electronic records, 2005-2008	Retrospective cohort study (3)	Registers	Adults, US	28.7, 28.8[c], 23.1, NA	DM-NS, HT, DL, heart disease	108	206	Fair
Vohra et al. (2017)[18]	Medicaid Analytic eXtract, 2000-2008	Retrospective cohort study (3)	Registers	Adults, US	28.6, 34.1 [22-64], 62.9, NA	DM-NS	1772	5320	Fair
Wallén et al. (2018)[19]	Central administrative database for	Retrospective cohort study (3)	Registers	Both (56.8), Sweden	31.6, 72.8 [0-85+], NA, NA	DM-NS, HT	13921	1996140	Fair

	Stockholm County,1998–2015								
Weir et al. (2021)[20]	Cambridge Autism Research Database, Autistica Discover Network, autism support groups and charities (including the Autism Research Trust) based online physical health survey	Retrospective cohort study (3)	Self-report	Both[b], UK	63.8, 41 [16-70+], 11.68, NA	DM-NS, HT, DL, heart disease	1156	1212	Fair
Weiss et al. (2018)[21]	Health Care Access Research and Developmental Disabilities, Ontario	Retrospective cohort study (3)	Registers	Adults, Canada	22.4, 20.4 [18-24], NA, NA	DM-NS, HT	5095	393263	Good
Zerbo et al. (2015)[22]	Kaiser Permanente Northern California, 1980-2003	Retrospective cohort study (3)	Registers	Both[b], US	18, 12.2 [12-35], NA, 2.7	T1DM	5565	27825	Good
Studies reporting laboratory parameters of autistic individuals and non-autistic controls allowing between-group comparisons									
Al-Bazzaz et al. (2020)[23]	Referred by specialized clinicians in Autism Academy of Jordan	Cross-sectional (4)	Registers	Children, Jordan	12.9, [4-12], NA, NA	FBS, Lipid profile	35	35	Fair
Blazewicz et al. (2020)[24]	Local support groups (mainly parents) or referred by specialized clinicians and therapists	Cross-sectional (4)	Registers	Both*, Poland	0, 17.3 [15-21], NA, NA	Lipid profile	35	37	Fair
Dziobek et al. (2007)[25]	Local Asperger support groups or referred by specialized clinicians.	Cross-sectional (4)	Registers	Adults, US	22.7, 40.8[c], NA, NA	FBS, Lipid profile	22	22	Fair
Hassan et al. (2019)[26]	Outpatients' psychiatric clinics of the Neuropsychiatric	Cross-sectional (4)	Registers	Children, Egypt	0, 7.13[c], 100, NA	TC	73	73	Good

	and Pediatric Departments of South Valley and Assiut University Hospitals, Egypt.								
Kim et al. (2010)[27]	Special education school for disabled children located in Seoul	Cross-sectional (4)	Registers	Children, South Korea	0, 10.1 [7-12], 100, NA	Lipid profile	29	29	Fair
Kwon et al. (2021)[28]	Specialized Korean schools (Gyeongjin School in Gyeonggi-do, Hyesung School and Haemaru School in Busan), 2017-2018	Cross-sectional (4)	Registers	Children, South Korea	30,3, 16.1[c], NA, NA	FBS, Lipid profile	33	271	Good
Manco et al. (2021)[29]	Child and Adolescence Neuropsychiatric Unit of the Bambino Gesù Hospital, 2017-2018	Cross-sectional (4)	Registers	Children, Italy	18, 10 [4-18], NA, NA	FBS	60	240	Good
Moses et al. (2014)[30],[d]	Medical charts of six hostels operated by Alut, the Israel National Autism Association, 2007-2008	Cross-sectional (4)	Registers	Adults, Israel	24, 31.1[c], NA, NA	FBS, Lipid profile	80	828	Good
Pearson et al. (2010)[31]	Oregon Health and Science University/ Child Development and Rehabilitation Center Autism Clinic, 2007-2009	Cross-sectional (4)	Registers	Children, US	16.7, 6.5[c], 17.9, NA	TC	42	27	Good
Slama et al. (2022)[32]	Fattouma Bourguiba Univer-sity Hospital, Monastir, Tunisia and	Cross-sectional (4)	Registers	Children, Tunisia	21.6, 7.3 [3-16], NA, NA	FBS, Lipid profile	51	40	Good

	Farhat Hached University Hospital, Sousse, 2018-2019								
Tierney et al. (2021)[33]	Autism Genetics Research Exchange (AGRE)	Cross-sectional (4)	Registers	Both[b], US	17.4, [4-19], NA, NA	TC, HDL	501	6445	Fair
Zurita et al. (2020)[34]	Those who attended school in the Metropolitan District of Quito	Cross-sectional (4)	Registers	Children, Ecuador	22.7, 8.9 [5-12], 100, NA	FBS, Lipid profile	25	34	Fair

[a] Rating scheme used has been modified from the Oxford Centre for Evidence-based Medicine for ratings of individual studies
[b] Cannot calculate percentage of children as children and adult distributions were not explained clearly
[c] Age ranges were not reported
[d] Study was deemed eligible after the initial abstract and subsequent full-text screening. However, the statistics reported in the study were not included in the meta-analyses due to selective exclusion of participants who had been treated with medications for cardiometabolic disease from the study
DM-NS-Diabetes mellitus (not-specified); T1DM-Type 1 diabetes mellitus; T2DM-Type 2 diabetes mellitus; HT-hypertension; DL-dyslipidemia; PVD-peripheral vascular disease; FBS-fasting blood sugar; TC-total cholesterol

eTable 5. Demographic Summaries of Individual Meta-analyzed Samples

Meta-analysis	Autism	Control	Female %; male: female ratio	Mean age [range]; % Children; Age Distribution	non-Caucasians %	Geographical Region
Diabetes mellitus	274950	7691364	24.5; 3:1	22.0 [3.8-72.83]; Children 28.0; Adults-9, Children-4, Both-7	28.0	US-12, Taiwan-3, Canada-3, Sweden-2
Hypertension	237672	3222718	24.3; 3:1	24.4 [8.8-72.8]; 25.9; Adults-7, Children-1; Both-4	27.6	US-7; Canada-2; Sweden-1; Taiwan-1; Denmark-1
Dyslipidemia	217395	772252	24.5; 3:1	23.6 [8.8-40.98]; 25.8; Adults-3, Children-1, Both-3	30.7	US-5, Canada-1, Taiwan-1
Macrovascular disease	163653	531492	26.3; 2.8:1	29.7 [28.48-71.3]; NA; Adult-6, Both -1	35.6	US-5, Canada-1, Denmark-1

eTable 6. Results of the Random-Effects Meta-regression Analyses That Examined the Heterogeneity and Moderator Effects of the Association Between Autism and Relative Risk of Diabetes

Model	Dependent Variable	k	Moderator	β	SE	95%CI	p-value
1	Relative risk of diabetes mellitus	14	Intercept	-0.289	0.325	-0.926, 0.348	0.374
			Non-Caucasian (%)	1.319	0.581	0.181, 2.456	0.023
		Residual heterogeneity: I^2 = 98.29%; τ^2 = 0.3843; QE = 445.367; p < 0.001 Moderator effect: QM (df = 1) = 5.161; p = 0.0231					
2	Relative risk of diabetes mellitus	14	Intercept	0.7807	0.234	0.323, 1.239	0.001
			Age (years)	-0.010	0.007	-0.023, 0.003	0.119
		Residual heterogeneity: I^2 = 97.65%; τ^2 = 0.298; QE = 971.636; p < 0.001 Moderator effect: QM (df = 1) = 2.427; p = 0.119					
3	Relative risk of diabetes mellitus	25	Intercept	0.740	0.261	0.229, 1.251	0.005
			Female (%)	-1.013	0.811	-2.602, 0.576	0.212
		Residual heterogeneity: I^2 = 98.62%; τ^2 = 0.318; QE = 1144.750; p < 0.001 Moderator effect: QM (df = 1) = 1.560; p = 0.212					
4	Relative risk of diabetes mellitus	11	Intercept	0.813	0.288	0.249, 1.378	0.005
			Obesity (%)	-2.984	1.800	-6.511, 0.544	0.097
		Residual heterogeneity: I^2 = 99.05%; τ^2 = 0.247; QE = 798.399; p < 0.001 Moderator effect: QM (df = 1) = 2.749; p = 0.097					
5	Relative risk of diabetes mellitus	25	Intercept (Other)	0.754	0.1676	0.425, 1.082	< 0.001
			Region (US)	-0.558	0.2286	-1.006, -0.110	0.015
		Residual heterogeneity: I^2 = 98.48%; τ^2 = 0.267; QE = 857.217; p < 0.001 Moderator effect: QM (df = 1) = 5.952; p = 0.015					
6	Relative risk of diabetes mellitus	25	Intercept	163.081	63.599	38.428, 287.733	0.010
			Year of publication	-0.081	0.032	-0.142, -0.019	0.011
		Residual heterogeneity: I^2 = 98.02%; τ^2 = 0.242; QE = 332.858; p < 0.001 Moderator effect: QM (df = 1) = 6.539; p = 0.011					
7	Relative risk of diabetes mellitus	25	Intercept (Adult)	0.289	0.156	-0.017, 0.594	0.064
			Both	0.008	0.256	-0.494, 0.510	0.976
			Children	0.754	0.282	0.202, 1.307	0.008
		Residual heterogeneity: I^2 = 98.35%; τ^2 = 0.243; QE = 634.261; p < 0.001 Moderator effect: QM (df = 2) = 8.011; p = 0.018					

eTable 7. Summary of Assessments for Publication Bias and Adjusted Outcomes

DV	Funnel Asymmetry	Number of Imputes	Random-effects model	p-value
FBS	Symmetrical	0	1.891 [-2.047, 5.829]	0.347
TC	Asymmetrical	7	-23.773 [-37.774; -9.773]	0.001
HDL	Symmetrical	0	-9.353 [-13.422; -5.284]]	< 0.001
LDL	Asymmetrical	3	34.734 [7.659; 61.808]	0.012
TG	Asymmetrical	3	9.873 [-10.532; 30.277]	0.343

eTable 8. Results of the Random-Effects Meta-regression Analyses That Examined the Heterogeneity and Moderator Effects of the Association Between Autism and Relative Risk of Hypertension

Model	Dependent Variable	k	Moderator	β	SE	95%CI	p-value
1	Relative risk of hypertension	7	Intercept	0.119	0.179	-0.233, 0.470	0.508
			Non-Caucasian (%)	-0.138	0.401	-0.925, 0.649	0.731
		Residual heterogeneity: I^2 = 96.42%; τ^2 = 0.071; QE = 219.817; p < 0.001 Moderator effect: QM (df = 1) = 0.118; p = 0.732					
2	Relative risk of hypertension	13	Intercept	0.603	0.190	0.231, 0.975	0.001
			Age (years)	-0.011	0.005	-0.020, -0.017	0.021
		Residual heterogeneity: I^2 = 97.39%; τ^2 = 0.120; QE = 759.915; p < 0.001 Moderator effect: QM (df = 1) = 5.336; p = 0.021					
3	Relative risk of hypertension	14	Intercept	0.522	0.231	0.068, 0.975	0.024
			Female (%)	-1.171	0.745	-2.630, 0.288	0.116
		Residual heterogeneity: I^2 = 99.10%; τ^2 = 0.149; QE = 1126.7445; p < 0.001 Moderator effect: QM (df = 1) = 2.474; p = 0.115					
4	Relative risk of hypertension	10	Intercept	0.156	0.241	-0.316, 0.628	0.516
			Obesity (%)	0.544	1.661	-2.711, 3.799	0.743
		Residual heterogeneity: I^2 = 99.49%; τ^2 = 0.192; QE = 758.417; p < 0.001 Moderator effect: QM (df = 1) = 0.107; p = 0.743					
5	Relative risk of hypertension	14	Intercept (Other)	0.209	0.163	-0.111, 0.528	0.200
			Region (US)	-0.024	0.233	-0.480, 0.432	0.919
		Residual heterogeneity: I^2 = 99.46%; τ^2 = 0.179; QE = 1396.59; p < 0.001 Moderator effect: QM (df = 1) = 0.010; p = 0.919					
6	Relative risk of hypertension	14	Intercept	73.661	90.433	-103.585, 250.907	0.415
			Year of publication	-0.036	0.045	-0.124, 0.051	0.417
		Residual heterogeneity: I^2 = 99.24%; τ^2 = 0.163; QE = 630.505; p < 0.001 Moderator effect: QM (df = 1) = 0.660; p = 0.417					
7	Relative risk of hypertension	14	Intercept (Adult)	0.100	0.104	-0.104,0.305	0.336
			Both	-0.076	0.221	-0.508, 0.356	0.730
			Children	0.826	0.249	0.339, 1.314	0.001
		Residual heterogeneity: I^2 = 99.01%; τ^2 = 0.089; QE = 1186.393; p < 0.001 Moderator effect: QM (df = 2) = 12.098; p = 0.002					

eTable 9. List of Excluded Studies

Reference	Cause
An J, DuBose KD, Decker JT, Hatala LE. A school-based mentoring program developing healthy behaviors of adolescents with intellectual and developmental disabilities: A pilot feasibility study. Disability and Health Journal. 2019;12(4):727-731.	No comparable control group
Brondino N, Fusar-Poli L, Miceli E, et al. Prevalence of medical comorbidities in adults with autism spectrum disorder. Journal of general internal medicine. 2019;34(10):1992-1994.	No comparable control group
Dumbuya A, Comnick C, Xie XJ, Marchini L. Types of dental procedures provided to adults with autism spectrum condition: A descriptive study. Special Care in Dentistry. 2021;41(5):553-558.	No comparable control group
Fortuna RJ, Robinson L, Smith TH, et al. Health conditions and functional status in adults with autism: A cross-sectional evaluation. Journal of General Internal Medicine. 2016;31(1):77-84.	No comparable control group
Gilmore D, Harris L, Longo A, Hand BN. Health status of Medicare-enrolled autistic older adults with and without co-occurring intellectual disability: An analysis of inpatient and institutional outpatient medical claims. Autism. 2021;25(1):266-274.	No comparable control group
Guinchat V, Cravero C, Diaz L, et al. Acute behavioral crises in psychiatric inpatients with autism spectrum disorder (ASD): recognition of concomitant medical or non-ASD psychiatric conditions predicts enhanced improvement. Research in developmental disabilities. 2015;38:242-255.	No comparable control group
Houghton R, De Vries F, Loss G. Psychostimulants/atomoxetine and serious cardiovascular events in children with ADHD or autism spectrum disorder. CNS drugs. 2020;34(1):93-101.	No comparable control group
Jain S, Andridge R, Hellings JA. Loxapine for reversal of antipsychotic-induced metabolic disturbances: a chart review. Journal of autism and developmental disorders. 2016;46(4):1344-1353.	No comparable control group
Jones KB, Cottle K, Bakian A, et al. A description of medical conditions in adults with autism spectrum disorder: A follow-up of the 1980s Utah/UCLA Autism Epidemiologic Study. Autism. 2016;20(5):551-561.	No comparable control group
Kohane IS, McMurry A, Weber G, et al. The co-morbidity burden of children and young adults with autism spectrum disorders. PloS one. 2012;7(4):e33224.	No comparable control group
Luo Y, Eran A, Palmer N, et al. A multidimensional precision medicine approach identifies an autism subtype characterized by dyslipidemia. Nature Medicine. 2020;26(9):1375-1379.	No comparable control group
Ptomey L, Walpitage D, Mohseni M, et al. Weight status and associated comorbidities in children and adults with Down syndrome, autism spectrum disorder and intellectual and developmental disabilities. Journal of Intellectual Disability Research. 2020;64(9):725-737.	No comparable control group
Saqr Y, Braun E, Porter K, Barnette D, Hanks C. Addressing medical needs of adolescents and adults with autism spectrum disorders in a primary care setting. Autism. 2018;22(1):51-61.	No comparable control group
Scahill L, Jeon S, Boorin SJ, et al. Weight gain and metabolic consequences of risperidone in young children with autism spectrum disorder. Journal of the American Academy of Child & Adolescent Psychiatry. 2016;55(5):415-423.	No comparable control group
Wise EA, Smith MD, Rabins PV. Aging and autism spectrum disorder: A naturalistic, longitudinal study of the comorbidities and behavioral and neuropsychiatric symptoms in adults with ASD. Journal of Autism and Developmental Disorders. 2017;47(6):1708-1715.	No comparable control group
Ames JL, Massolo ML, Davignon MN, Qian Y, Croen LA. Healthcare service utilization and cost among transition-age youth with autism spectrum disorder and other special healthcare needs. Autism. 2021;25(3):705-718.	Prevalence of any considered outcomes in a

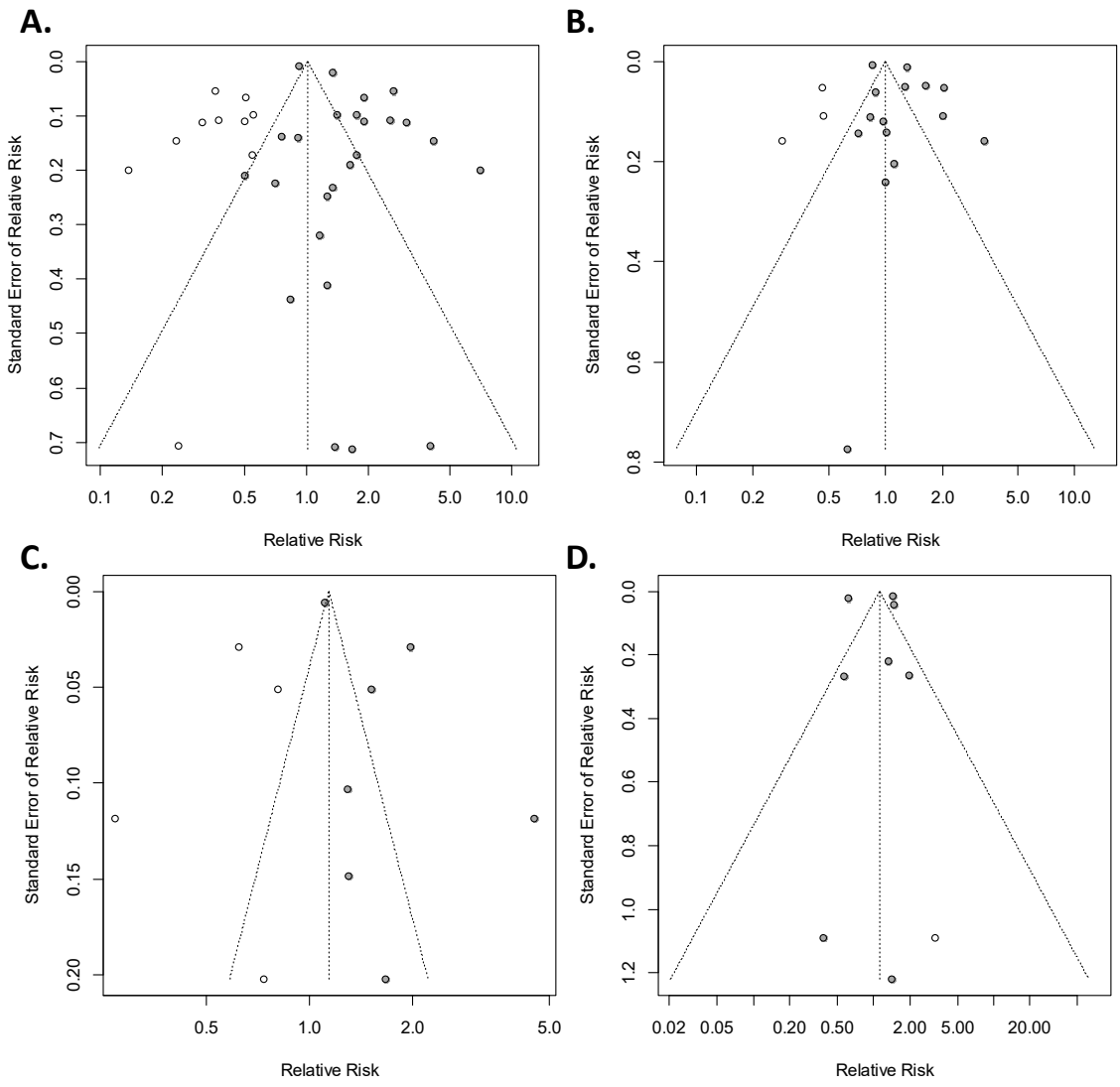
	sample of individuals with autism spectrum disorders not reported
Esteban-Figuerola P, Morales-Hidalgo P, Arija-Val V, Canals-Sans J. Are there anthropometric and body composition differences between children with autism spectrum disorder and children with typical development? Analysis by age and spectrum severity in a school population. Autism. 2021:1362361320987724.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Luçardo JdC, Monk GF, Dias MdS, et al. Interest in food and triglyceride concentrations in children and adolescents with autistic spectrum disorder. Jornal de pediatria. 2021;97:103-108.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Usui N, Iwata K, Miyachi T, et al. VLDL-specific increases of fatty acids in autism spectrum disorder correlate with social interaction. EBioMedicine. 2020;58:102917.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Kolachahi SA, AdibSaber F, Zidashti ZH, Elmieh A, Bidabadi E, Hosseinkhanzadeh AA. Water-based training in combined with vitamin D supplementation improves lipid profile in children with ASD. Research in Autism Spectrum Disorders. 2020;76:101603.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Hirai T, Usui N, Iwata K, et al. Increased plasma lipoprotein lipase activity in males with autism spectrum disorder. Research in autism spectrum disorders. 2020;77:101630. doi:10.1016/j.rasd.2020.101630	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Benachenhou S, Etcheverry A, Galarneau L, Dubé J, Çaku A. Implication of hypocholesterolemia in autism spectrum disorder and its associated comorbidities: A retrospective case-control study. Autism Res. Dec 2019;12(12):1860-1869. doi:10.1002/aur.2183	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders cannot be calculated
Stanek KR, Youngkin EM, Pyle LL, Raymond JK, Driscoll KA, Majidi S. Prevalence, characteristics, and diabetes management in children with comorbid	Prevalence of type 1 diabetes in a

autism spectrum disorder and type 1 diabetes. Pediatric diabetes. 2019;20(5):645-651.	sample of individuals with autism spectrum disorders not reported
Román PÁL, Salvador MS, Sánchez JS, Pinillos FG. Low level of physical fitness is an early feature in preschool children with autism. Retos: nuevas tendencias en educación física, deporte y recreación. 2019;(35):348-350.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Tolchard B, Stuhlmiller C. Chronic health and lifestyle problems for people diagnosed with autism in a student-led clinic. Advances in Autism. 2018;	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders cannot be calculated
Castro K, Faccioli LS, Baronio D, Gottfried C, Perry IS, Riesgo R. Body composition of patients with autism spectrum disorder through bioelectrical impedance. Nutricion hospitalaria. 2017;34(4):875-879.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
McDermott S, Moran R, Platt T, Issac T, Wood H, Dasari S. Depression in adults with disabilities, in primary care. Disability and rehabilitation. 2005;27(3):117-123.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Schott W, Tao S, Shea L. COVID-19 risk: Adult Medicaid beneficiaries with autism, intellectual disability, and mental health conditions. Autism. 2022;26(4):975-87.	Overlap with another included study[14]
Chen MH, Tsai SJ, Bai YM, Huang KL, Su TP, Chen TJ, Hsu JW. Type 1 diabetes mellitus and risks of major psychiatric disorders: A nationwide population-based cohort study. Diabetes & Metabolism. 2022;48(1):101319.	Prevalence of type 1 diabetes in a sample of individuals with autism spectrum disorders not reported
Liu S, Kuja-Halkola R, Larsson H, Lichtenstein P, Ludvigsson JF, Svensson AM, Gudbjörnsdottir S, Tideman M, Serlachius E, Butwicka A. Neurodevelopmental Disorders, Glycemic Control, and Diabetic Complications in Type 1 Diabetes: a Nationwide Cohort Study. The Journal of Clinical Endocrinology & Metabolism. 2021;106(11):e4459-70.	Prevalence of type 1 diabetes in a sample of individuals with autism spectrum disorders not reported

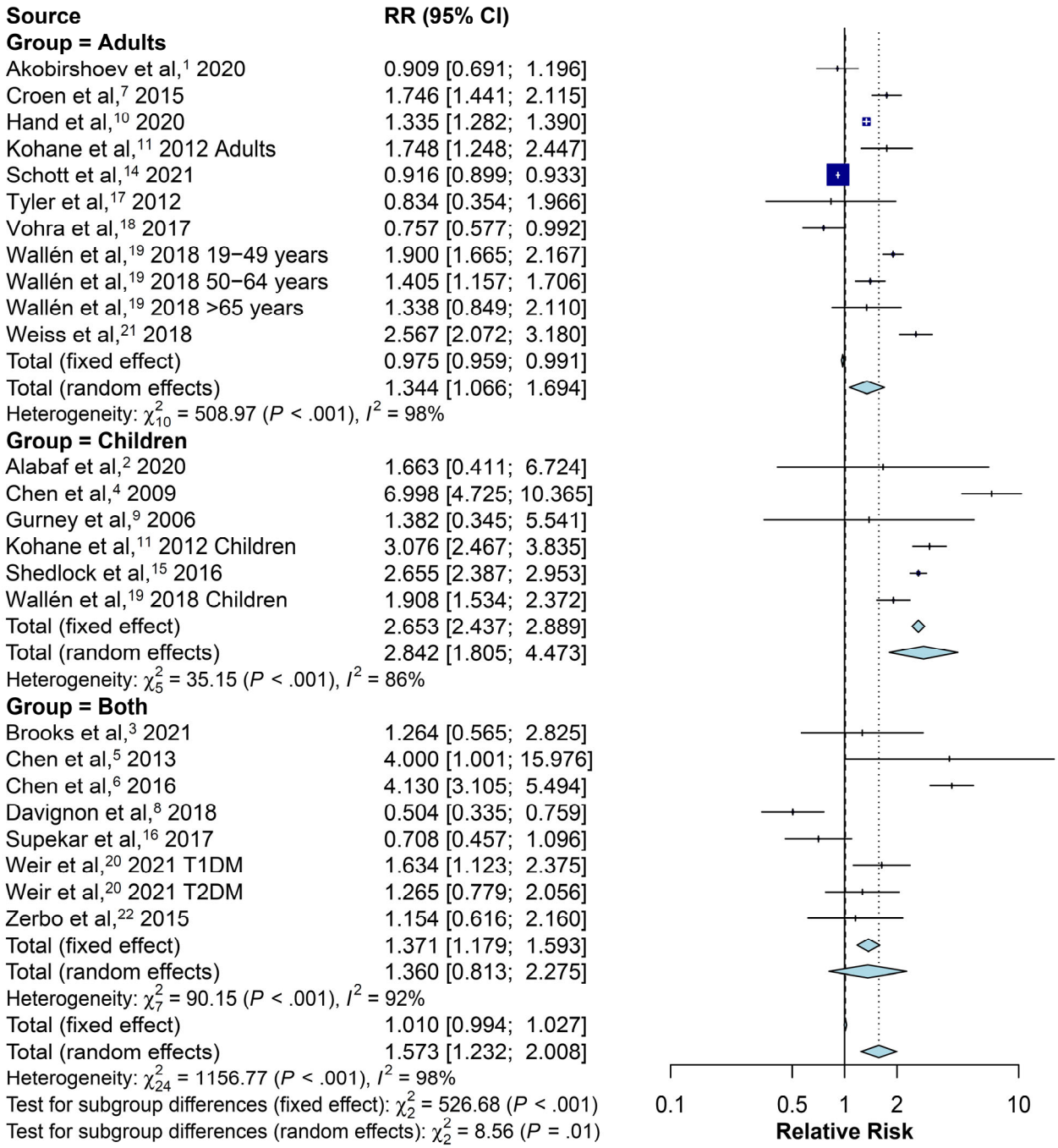
Kennedy N, Kennedy J, Kerr M, Dredge S, Brophy S. Health checks for adults with intellectual disability and association with survival rates: a linked electronic records matched cohort study in Wales, UK. BMJ open. 2022;12(4):e049441.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Cooper SA, Henderson A, Kinnear D, Mackay D, Fleming M, Smith GS, Hughes-McCormack LA, Rydzewska E, Dunn K, Pell JP, Melville C. Cohort profile: Scotland's record-linkage e-cohorts of people with intellectual disabilities, and autistic people (SCIDA). BMJ open. 2022;12(5):e057230.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Thom RP, Palumbo ML, Keary CJ, Hooker JM, McDougle CJ, Ravichandran CT. Prevalence and factors associated with overweight, obesity, and hypertension in a large clinical sample of adults with autism spectrum disorder. Scientific Reports. 2022;12(1):1-1.	No comparable control group
McLeod, J. D., Hawbaker, A., & Meanwell, E. (2021). The health of college students on the autism spectrum as compared to their neurotypical peers. Autism, 25(3), 719-730.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported
Simantov T, Pohl A, Tsompanidis A, Weir E, Lombardo MV, Ruigrok A, Smith P, Allison C, Baron-Cohen S, Uzefovsky F. Medical symptoms and conditions in autistic women. Autism. 2022;26(2):373-88.	Prevalence of any considered outcomes in a sample of individuals with autism spectrum disorders not reported

eFigure 1. Funnel Plot Depicting Publication Bias and Imputed Effect Sizes to Correct for Publication Bias for Cardiometabolic Risk Factors

A. Diabetes mellitus, B. Hypertension, C. Dyslipidemia, D. Macrovascular complications



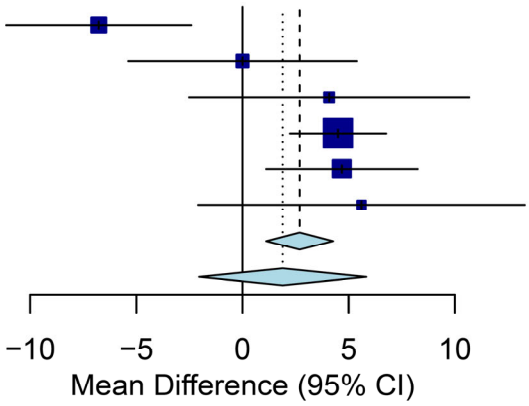
eFigure 2. Results of Random-Effects Meta-analysis Examining the Relative Risk of Diabetes With Subgroup Analysis for Age Groups



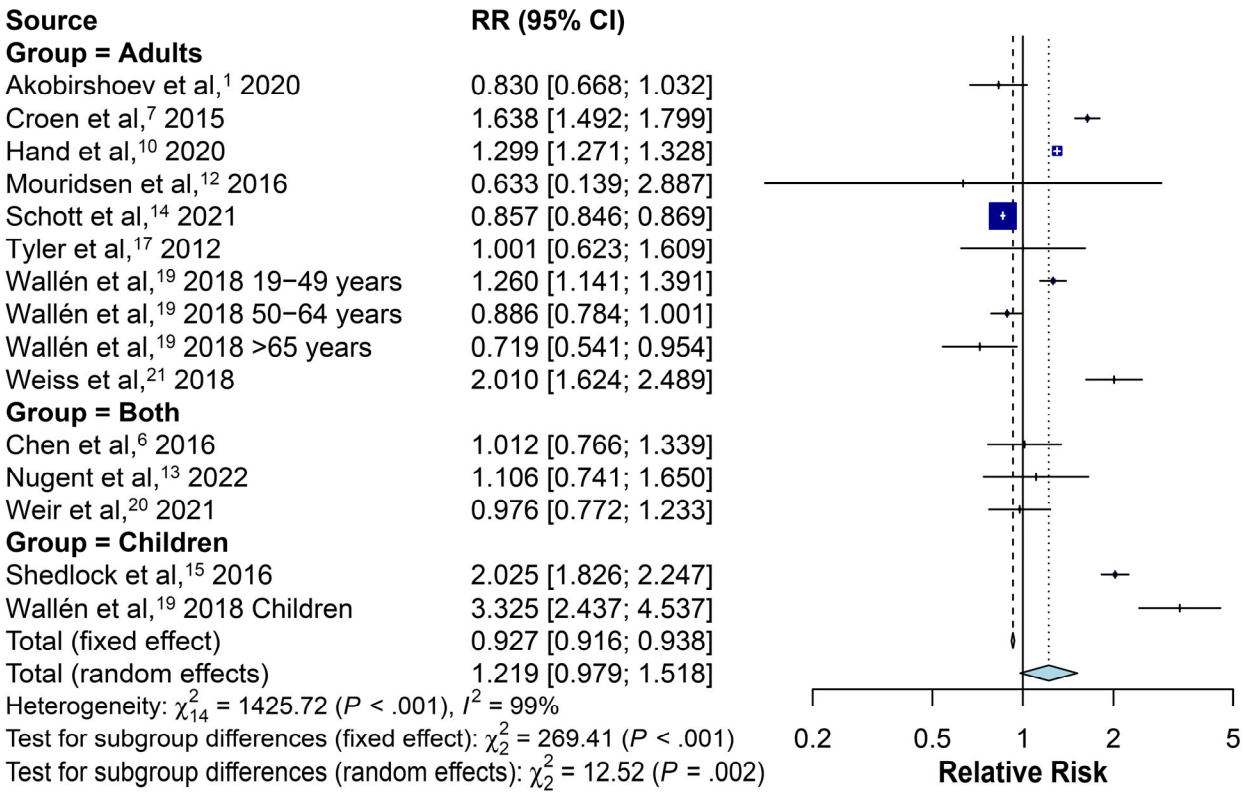
eFigure 3. Results of Random-Effects Meta-analysis Examining the Mean Difference of Fasting Blood Glucose Levels Between Autistic and Nonautistic Individuals

Source	MD (95% CI)
Al−Bazzaz et al,[23] 2020	−6.77 [−11.13; −2.41]
Dziobek et al,[25] 2007	0.00 [−5.38; 5.38]
Kwon et al,[28] 2021	4.08 [−2.51; 10.67]
Manco et al,[29] 2021	4.50 [2.24; 6.76]
Slama et al,[32] 2022	4.68 [1.11; 8.25]
Zurita et al,[34] 2020	5.60 [−2.09; 13.29]
Total (fixed effect)	2.69 [1.11; 4.27]
Total (random effects)	1.89 [−2.05; 5.83]

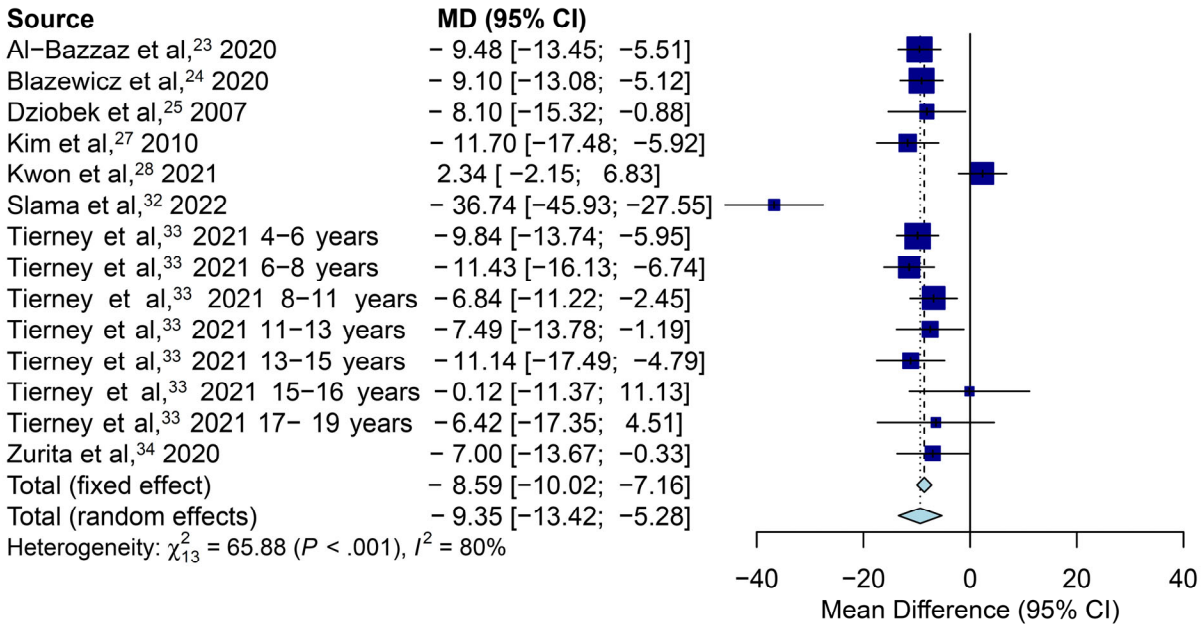
Heterogeneity: $\chi^2_5 = 23.44$ ($P < .001$), $I^2 = 79\%$



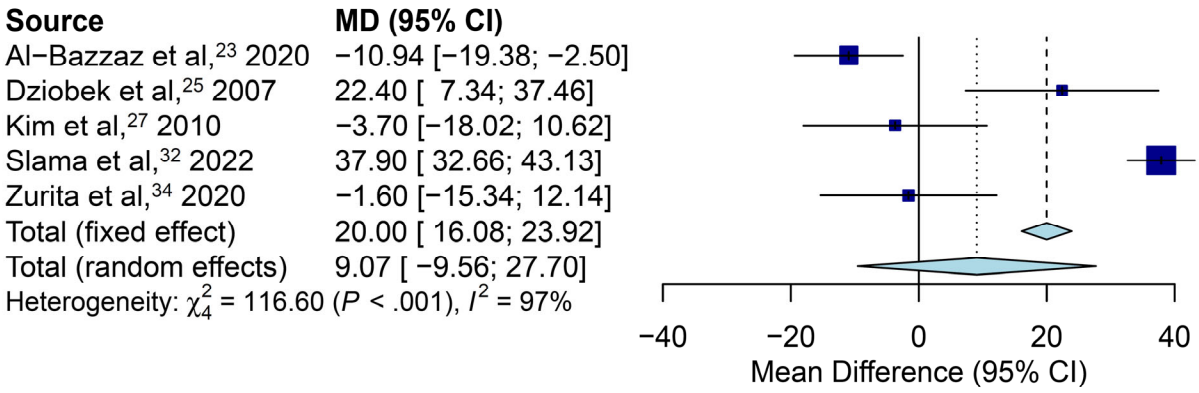
eFigure 4. Results of Random-Effects Meta-analysis Examining the Relative Risk Hypertension With Subgroup Analysis for Age Groups



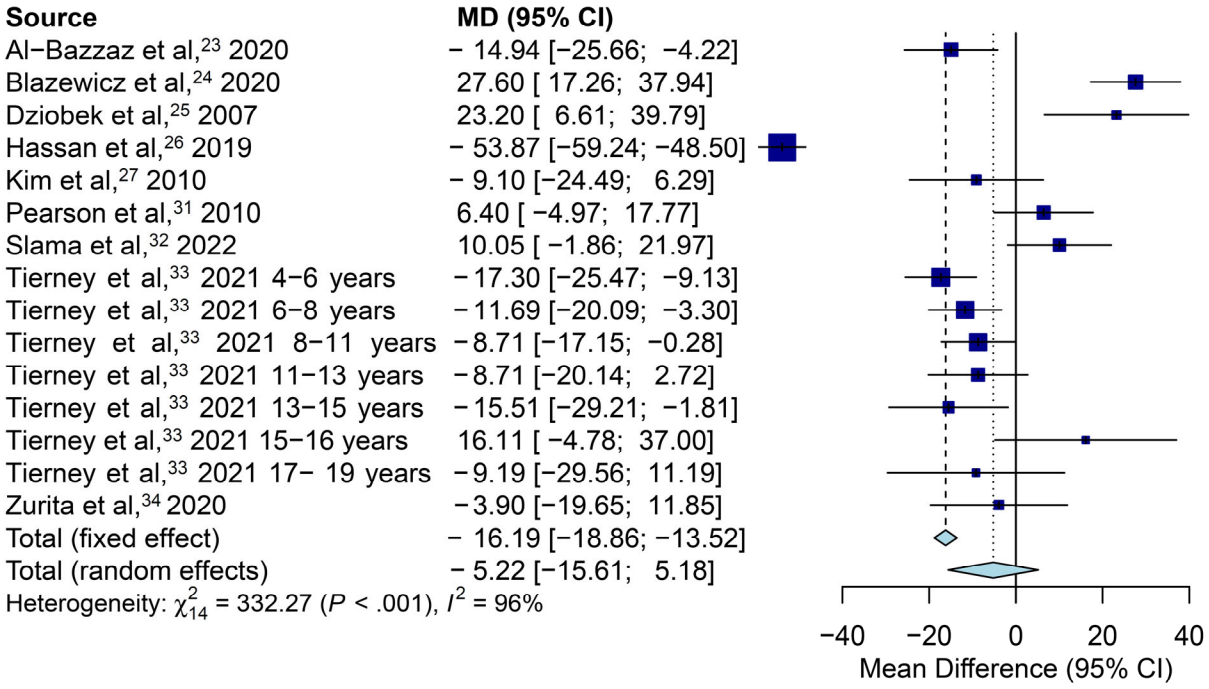
eFigure 5. Results of Random-Effects Meta-analysis Examining the Mean Difference of High-Density Cholesterol Levels Between Autistic and Nonautistic Individuals



eFigure 6. Results of Random-Effects Meta-analysis Examining the Mean Difference of Low-Density Cholesterol Levels Between Autistic and Nonautistic Individuals



eFigure 7. Results of Random-Effects Meta-analysis Examining the Mean Difference of Total Cholesterol Levels Between Autistic and Nonautistic Individuals



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