The Role of Advanced Imaging techniques in predicting cardiovascular outcomes in Asymptomatic Individuals

ABSTRACT:

Background: Global trends in cardiovascular death have declined and survival rates have decreased over the last 30 years as a result of advancements in medical and interventional therapy.

Objectives: The aim of this systematic evaluation and meta-assessment is to evaluate the predictive efficacy of superior imaging techniques, in particular, CCTA, in asymptomatic people, aiming to elucidate their potential advantages and disadvantages for screening purposes and offer insights into their suitability for risk stratification and control on this populace, with the purpose of informing future scientific recommendations and practices in cardiovascular screening.

Methods: PubMed and Cochrane Library were searched thoroughly for literature search. Ten articles were extracted to be included in this study.

Results: A total of ten studies were included in this systematic review and meta-analysis. All of the included studies were cohorts either retrospective or prospective cohorts. Meta-analysis was performed for two variables that are Cardiovascular Mortality and MACE. The cardiovascular mortality was shown to be improved with the use of Coronary Computed Tomographic Angiography (CCTA). Only one study reported the quantitative effect of CCTA on MACE.

Conclusion: To conclude, our systematic overview and meta-analysis highlight the tremendous position of CCTA in predicting cardiovascular consequences in asymptomatic individuals, suggesting its potential as a precious danger assessment tool for detecting CAD and enhancing cardiovascular mortality prediction, though similar research is wanted to verify its definitive role in medical practice.

Abbreviation:

Coronary Computed Tomographic Angiography: CCTA

Myocardial infarction: MI

Cardiovascular disease: CVD

Atherosclerotic cardiovascular disease: ASCVD

Major Adverse Cardiovascular Events: MACE

INTRODUCTION:

Over the past 30 years, advances in medical and interventional therapy have led to a decline in global trends in cardiovascular death and a reduction in survival rates [1]. Despite this, it continues to be the leading cause of death, responsible for nearly 2000 fatalities every day in the US and one-third of all deaths worldwide [2]. Many important observational studies, like the Framingham Heart Study, which discovered important cardiovascular risk factors, provide support for our knowledge of the etiology of cardiovascular disease [3]. Cardiovascular screening in asymptomatic patients aims to identify intermediate- or high-risk patients. The goal is to start taking action to lower their risk of cardiovascular mortality and other ischemic events, such as myocardial infarction [4]. Many prevention strategies have been proposed.

The application of imaging for determining an adult's cardiovascular risk despite being asymptomatic has received a lot of attention, but not without controversy [5]. Subclinical atherosclerosis screening may be beneficial to a considerable portion of the population. In the US, cardiovascular disease is the leading cause of mortality (around 35 percent) [6]. In 40–60% of instances, major occlusive atherosclerotic cardiovascular events—such as myocardial infarction or sudden cardiac death—are the initial signs of atherosclerotic disease. It may be beneficial for these initially asymptomatic but at-risk people to have a subclinical atherosclerosis screening [7]. The consequences of the SCOT-HEART trial established that adding coronary computed tomography angiography (CCTA) to the usual care plan for sufferers experiencing chest aches at low-to-intermediate danger improves scientific judgment, reduces the want for invasive coronary angiography (CAD), and maximizes medical remedy, all of which lead to better patient outcomes [8]. When CCTA turned into brought to standard care, there was a 41% decrease in the danger of nonfatal myocardial infarction (MI) or cardiovascular (CV) death, according to a 5-12 months follow-up [9]. Furthermore, CCTA is more effective than purposeful trying at predicting activities, as tested by using the Prospective Multicenter Imaging Study for Evaluation of Chest Pain (PROMISE) trial, which additionally tested its usefulness in identifying non-obstructive coronary artery disorder (CAD) [10]. All things considered, CCTA reveals better risk stratification, improving protection, the usage of preventive capsules, and diagnostic accuracy. Cardiovascular institutions have begun to launch initial hints helping using CCTA as the first-line method of diagnosing CAD in symptomatic patients, as proof for this technique grows [11-13]. On the other hand, most contemporary pointers for the control of asymptomatic sufferers recommend in opposition to using CCTA for CAD screening. This is brought on by the opportunity of supplemental approaches like revascularization, which have no longer been confirmed to provide a particular gain and useless medicinal drug remedies. Despite this, a number of establishments continue to use CCTA screenings as a part of their screening packages for asymptomatic people who have hazard elements, which makes it hard to determine the best route of action based on CCTA effects [14,15] (Figure 1).

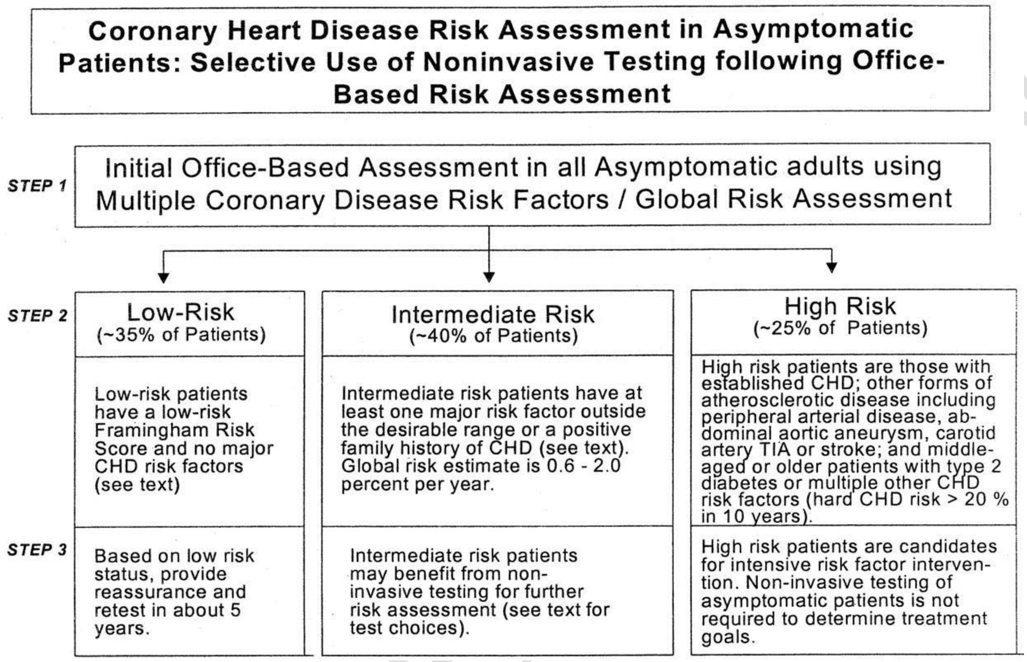

Fig 1: CHD Risk Assessment in Asymptomatic Patients

The motive of this systematic review and meta-evaluation is to evaluate how nicely advanced imaging methods, especially CCTA, predict cardiovascular consequences in those who do now not exhibit any signs. We intend to elucidate the feasible benefits and drawbacks of these imaging strategies in a screening place by synthesizing the to-be-had records. Our analysis will provide important insights into the suitability of superior imaging for chance stratification and management in asymptomatic populations, given the contradictory tips and the big use of CCTA in practice. This research will add to the contemporary dialogue approximately using superior imaging strategies in cardiovascular screening and help shape destiny clinical pointers and practices in this vicinity.

METHODOLOGY:

Study Design: For this study, we performed a scientific assessment and meta-evaluation. We formulated our systematic review question on the use of the populace, intervention, comparison, and final results (PICO) framework (Table 1).

Population (P)	Asymptomatic individuals with risk factors for cardiovascular disease (CVD)
Intervention (I)	Advanced imaging techniques, specifically coronary computed tomography angiography (CCTA)
Comparison (C)	Standard care without advanced imaging or other non-invasive testing methods (e.g., functional testing)
Outcomes (O)	Primary Outcomes: Most Adverse Cardiac Event (MACE), cardiovascular death
Study Design (S)	Clinical trials and observational studies

Table 1: PICOS Framework

Eligibility Criteria:

The PICOS framework (Population, Intervention, Comparison, Outcome, and Study Design) is used to outline the eligibility standards for studies, following the suggestions set by means of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The inclusion criteria for this systematic evaluation and meta-evaluation are as follows:

1. Studies involving asymptomatic individuals with risk factors for cardiovascular disease (CVD). 2. Studies assessing the use of advanced imaging techniques, specifically coronary computed tomography angiography (CCTA). 3. Studies reporting on cardiovascular outcomes such as myocardial infarction, cardiovascular death, changes in clinical management, use of preventive medications, and rates of unnecessary procedures. 4. Research articles written in English. 5. Research with articles in full text accessible.

The following are the exclusion criteria: 1. Studies involving symptomatic patients or those without specified risk factors for CVD. 2. Studies that do not focus on advanced imaging techniques or specifically CCTA. 3. Research with inadequate information or results unrelated to the question under investigation. 4. Research published in languages other than English because there aren't enough resources for translation. 5. Overlapping datasets from the same research population or duplicate publications.

Search Strategy:

The strategy for this systematic review concerned an intensive literature search using databases consisting of PubMed and the Cochrane Library, adhering to PRISMA suggestions. Various journal titles, abstracts, and complete-textual content articles have been retrieved. Boolean operators AND/OR have been applied to refine the hunt, and multiple filters have been applied to ensure specificity (Table 2).

Database	Search String	Number of Hits
PubMed	((("Coronary Computed Tomography Angiography"[Mesh] OR "CCTA" OR "Coronary CT Angiography" OR "Coronary CTA" OR "Computed Tomography Angiography" OR "CT Angiography") AND ("Cardiovascular Diseases"[Mesh] OR "Cardiovascular Disease" OR "Heart Diseases" OR "Coronary Artery Disease" OR "CAD" OR "Coronary Disease" OR "Heart Disease")) AND ("Asymptomatic Diseases"[Mesh] OR "Asymptomatic Individuals" OR "Asymptomatic Patients" OR "Asymptomatic Population")) AND ("Risk Factors"[Mesh] OR "Risk Factor" OR "Risk Stratification") AND ("Predictive Value of Tests"[Mesh] OR "Prognosis" OR "Outcome Assessment (Health Care)" OR "Cardiovascular Outcomes" OR "Clinical Outcomes") AND (("2005/01/01"[PDAT] : "2013/12/31"[PDAT]) AND (English[lang]))	206
Cochrane Library	#1: "Coronary Computed Tomography Angiography" OR "CCTA" OR "Coronary CT Angiography" OR "Coronary CTA" OR "Computed Tomography Angiography" OR "CT Angiography" #2: "Cardiovascular Diseases" OR "Cardiovascular Disease" OR "Heart Diseases" OR "Coronary Artery Disease" OR "CAD" OR "Coronary Disease" OR "Heart Disease" #3: "Asymptomatic Diseases" OR "Asymptomatic Individuals"	73

	OR "Asymptomatic Patients" OR "Asymptomatic Population" #4: "Risk Factors" OR "Risk Factor" OR "Risk Stratification" #5: "Predictive Value of Tests" OR "Prognosis" OR "Outcome Assessment" OR "Cardiovascular Outcomes" OR "Clinical Outcomes"	

Table 2: Search Strategy for the SRMA

Data Extraction:

The systematic evaluation is guided with the aid of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement. As a part of the methodology, a radical search of various digital databases, such as PubMed and the Cochrane Library, was performed.

The article screening procedure consisted of phases. In the primary section, the titles and abstracts of all articles identified inside the decided-on electronic databases were reviewed. From this evaluation, a listing of papers was compiled for ability inclusion. In the second segment, the overall texts of the articles that exceeded the initial screening were acquired and reviewed.

For each eligible paper, uniform records extraction tables have been used to document records on the first creator, book year, examine the layout Of study, area, population, pattern length, intervention, contrast, effects, approach and well-known deviations, and associated factors. Disagreements had been resolved via discussion and by using the judgment of the senior creator. Two separate, blinded authors performed the thing screenings.

Selection Process:

To meet the inclusion standards, we searched peer-reviewed journals and courses for relevant literature. Studies had been "included" or "excluded" based totally on the predefined criteria. Ultimately, ten studies have been selected for the final evaluation and evaluation. Research that no longer meets the eligibility criteria becomes categorized as "dispute" or "exclusion." Exclusion standards were carried out earlier than putting off a take-look at attention. Studies have been disqualified for the following reasons: (1) problems with the population; (2)

discovery of an excessive threat of bias; (3) size of faulty outcomes; or (4) subpar look at the layout for the functions of our evaluation. Occasionally, more than one exclusion element compounded the choice to exclude a look at.

Statistical Analysis: Data for each variable was manually extracted for meta-analysis. For dichotomous variables, the total sample length and activities were recorded for each experimental and control group. For continuous variables, imply, popular deviation (SD), and general sample sizes were gathered for both organizations. The unique plan for crossover research is to extract information from paired t-checks to examine every subject's intervention and manage measurements. However, because of the scarcity of such facts, an opportunity method was followed. This careful statistics extraction approach can also have confined the ability of crossover studies to discover proper intervention consequences. When SD changed into now not provided inside the number one studies, fashionable blunders (SE) become used to calculate it. Additionally, whilst facts were supplied graphically (e.g., figures), numerical values were predicted for the results. All relevant food or flavonoid corporations and trials with pertinent final results facts were blanketed in the number one analyses. Heterogeneity, or real version in effect sizes, turned into assessed using a threshold of $P < 0.1$, with a 50% threshold considered huge to gauge the diploma of discrepancy among research.

Heterogeneity and reporting bias:

In a meta-evaluation, assessing heterogeneity is important for figuring out whether or not the variations among the protected research are sufficient to have an effect on the general outcomes. This evaluation is critical for ensuring the accuracy and reliability of the meta-evaluation findings. Besides the R^2 statistic, heterogeneity can be assessed with the use of the I^2 and τ^2 facts. The I^2 statistic quantifies the share of variability in effect estimates that is because of heterogeneity rather than sampling mistakes, whilst the τ^2 statistic estimates the between-observe variance. Additionally, the Cochran Q statistic can be employed to test the speculation that versions in examine effects are because of actual differences within the populace being studied as opposed to via hazard.

Quality Assessment: The quality assessment included three broad categories of questions: (1) Were the findings of the study validated? (2) What were the results? (3) Are the findings of the study applicable locally? 11 questions for quality assessment were answered after careful consideration of study designs and findings. The questions were answered with "Yes", "No", and "Can't tell". If you answered "yes" to the first question, you should answer the remaining questions. There is some overlap in the questions. The explanations for the answers and comments from researchers have been included.

RESULTS:

Data Items:

Following the entirety of the secondary screening method, an intensive exam of the whole pattern length (n=10) from the selected literature was performed. The researchers adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tips to create a PRISMA Flow Diagram. Figure 2.0 illustrates the observed selection method, detailing the identification, screening, eligibility, and inclusion levels of research from journals and other unbiased assets based on record availability [16].

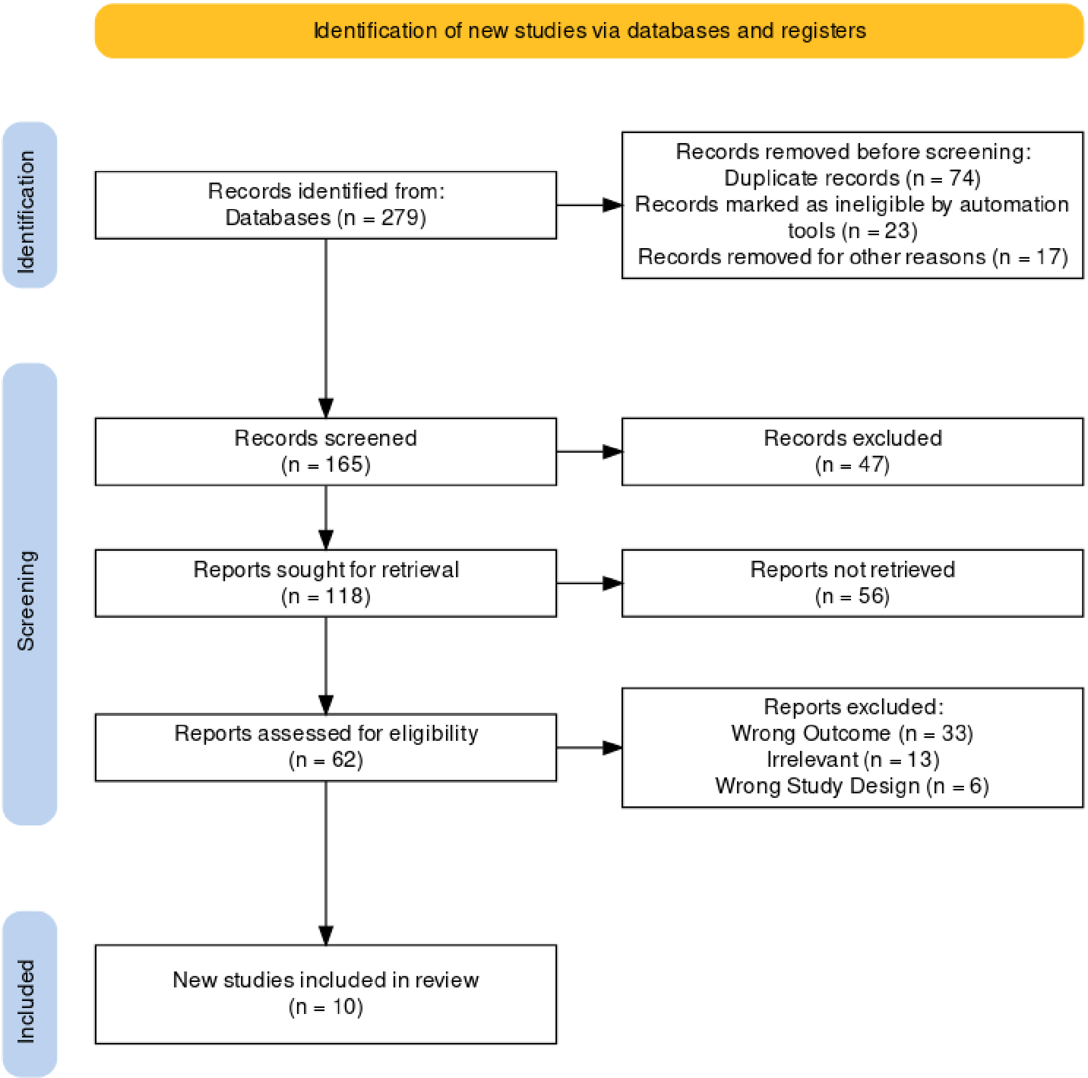

Fig 2: PRISMA FlowChart for the included studies

Study Characteristics:

Sr No.	Study ID	Location	Study Design	Sample size	Participants	Mean Age	Intervention	Main findings
1	Moon SJ et al. (2019) [17]	South Korea	A community-based prospective cohort study	470	All asymptomatic participants aged ≥65 years were enrolled in the study, and underwent	75.1+ 7.3	Medical histories were obtained from the personal interview or medical records. The 10-year Framingham risk score (FRS) and the 10-year atherosclerotic cardiovascular disease (ASCVD) risk score	The normal, nonobstructive, and obstructive groups had 8-year event-free survival rates of 98.1~1.1%, 94.9~1.6%, and 81.7~4.8%, respectively. Compared with the Framingham risk score and coronary artery calcium score model, CCTA improved risk prediction by C-

					coronary computed tomographic angiography (CCTA)		were calculated	index (from 0.698 to 0.749) a
2	Limpijankit T et al. (2023) [18]	Thailand	A Retrospective Cohort Study	9338	A total of 9,338 patients were analyzed after their CCTA procedures between 2005 and 2013. These patients included both symptomatic patients with suspected CAD and asymptomatic individuals with risk factors.	-	A total of 9338 patients were included in this retrospective analysis, categorized into three groups based on the degree of coronary stenosis determined by CCTA.	With hazard ratios (95% CI) of 0.43 (0.32, 0.58), 0.47 (0.34, 0.64), and 0.46 (0.31, 0.69), respectively, patients treated with statins alone had the lowest likelihood of developing MACEs in all three groups when compared to those receiving no treatment. This was after controlling for confounding variables. When treating patients with obstructive CAD, a combination of early revascularization or the use of statins and aspirin was linked to a decreased risk of MACEs when compared to no treatment, with hazard ratios of 0.43 (0.33, 0.58) and 0.64 (0.43, 0.97), respectively.
3	Ng et al. (2020) [19]	China	prospective cohort study	13	Between June 2017 and August 2018, we enrolled 63 asymptomatic diabetic patients (mean age 66 years±4.4 years; 77.8% male); their Framingham risk score was ≥20%. To calculate the normal global myocardial perfusion reserve index (MPRI), normal volunteers were enlisted.	66 years± 4.4 years	All subjects underwent testing and measurements using the global MPRI and adenosine stress CMR. Catheter coronary angiography (CCA) with or without fractional flow reserve (FFR) measurements was recommended for positive stress cardiac resonance (SMR) cases. A positive coronary narrowing of 70% or an FFR of 0.8 was defined as a positive CCA.	Of the 5 patients (7.9%) with infarcts found, 2 did not have any defects in stress perfusion. One patient chose not to have a coronary artery stent placed, while 12 patients had stents placed. Compared to normal volunteers (n=7), DM patients had a lower global MPRI (1.43±0.27 vs. 1.83±0.31 respectively; p<0.01).

4	Kuznetsova et al. (2022) [20]	USA	Retrospective cohort study	1407	Participants: 1407 people who lived in the community (mean age: 51.2 years; 51.1% were women; 53.5% had cardiovascular risk factors)	51.2 years	echocardiography	26 subjects (1.85%) were classified as having the advanced stage (Grade 2) in accordance with the 2016 recommendations, while the diastolic function was indeterminate in 109 participants (7.75%). Using the population-derived criteria, 17.9% of the sample (n = 252) had advanced LVDDF. Adverse cardiac events occurred in 100 participants over the course of the 8.4-year follow-up period. Following complete adjustment, we found no discernible variations in the risk of events between subjects classified in accordance with the 2016 recommendation and subjects with indeterminate or any grade of LVDDF and subjects with normal diastolic function.
5	Warren et al. (2024) [21]	Australia	Cohort	100	100 intermediate-risk patients	61±6	hundred patients at intermediate risk had double-blinded coronary CT angiograms. Data were cross-referenced with the National Death Index during a 10-year follow-up.	MACE affected 17 patients (20.5%), with 2 (2%) deaths, 8 (10%) ACS, 3 (4%) strokes, and 5 (6%) revascularization procedures among the events. Mixed plaque was present in 47 patients (57%) and was associated with a higher risk of MACE (OR 4.68 (95% CI 1.19 to 18.5), p=0.028).
6	Low et al. (2020) [22]	Singapore	retrospective observational study	135	226 myocardial perfusion imaging (MPI) scans were performed on 135 kidney transplant recipients (KTR) over a follow-up period of 10 (7–13) years.	43	radionuclide imaging and long-term outcomes after kidney transplantation	Only MI predicted MACE (all p<0.05); higher levels of low-density lipoprotein, proteinuria >0.3 g/day, and MI independently predicted the composite outcome. The positive predictive value for MACE increased from 17 to 25% in the 91 patients who had two serial MPIs. The composite outcome had a 93% negative predictive value if MI was absent, and 83% for MACE.

7	Cho et al. (2020) [23]	Korea	prospective observational study	39,906	From January 2007 to December 2013, 39,906 patients who did not have coronary artery disease (CAD) underwent coronary CTA.	56	Coronary Computed Tomographic Angiography	6108 patients (15.3%) with obstructive CAD were found by coronary CT scan (23.7% of symptomatic patients and 9.3% of asymptomatic patients). In 19.2% of symptomatic patients (appropriate, 80.6%) and 3.9% of asymptomatic patients (appropriate, 7.9%), a subsequent cardiac catheterization was carried out. Patients with obstructive CAD on CTA had a significantly higher 5-year rate of death or myocardial infarction (7.2% versus 3.0%; P<0.001; adjusted hazard ratio [95% CI], 1.34 [1.17–1.54]) than those without CAD.
8	Le et al. (2020) [24]	Singapore	prospective cohort study	160	Prospectively recruited subjects (n = 100) were healthy individuals without a clinical or family history of cardiovascular disease, or symptoms.	38 ± 11	exercise stress cardiovascular magnetic resonance	When this threshold was applied to G-P+ patients, it was found that those with a peakCI below the 35th percentile exhibited traits that were consistent with confirmed DCM, whereas those with a higher peakCI were younger, more active, and had a higher longitudinal strain. Only patients with low exercise capacity experienced adverse cardiovascular events (P = 0.004).
9	Yoon et al. (2020) [25]	Korea	Retrospective cohort study	1418	In this retrospective study, 1418 acute stroke patients without a history of heart disease underwent CCTA, which included CACS.	68.0 ± 12.2	coronary computed tomography angiography (CCTA)	The highest incidence of MACE was seen in patients with high-risk plaque type, which was followed by non-calcified, mixed, and calcified plaque, in that order (log-rank p < 0.001). When compared to FRS or the FRS + CACS model (all p < 0.05), the addition of stenosis degree to FRS improved risk reclassification and discrimination among the MACE prediction models.
10	Pickhardt et al. (2020) [26]	USA	retrospective cohort study	9223	Between 2004 and 2016, a single medical center screened 9223 generally healthy consecutive asymptomatic outpatient adults (mean age, 57.1 years; 5152 women, 4071	57.1 years	Automated CT biomarkers	For these same CT measures, the univariate hazard ratios (with 95% confidence intervals) for the highest-risk quartile in comparison to others were 4.53(3.82–5.37)/3.58(3.02–4.23)/2.28(1.92–2.71)/1.82(1.52–2.17)/2.73(2.31–3.23), whereas the corresponding values for BMI and FRS were 1.36(1.13–1.64) and 2.82(2.36–3.37), respectively. Cardiovascular

					men) for colorectal cancer using low-dose unenhanced abdominal CT as part of routine health maintenance.			events showed similar noteworthy trends.

Table 3: Study Characteristics of all included studies [17-26]

Meta-Analysis:

Data from more than one research research were accumulated for this research to conduct a scientific review and meta-analysis. All variables have been dichotomous, so activities and totals had been extracted for every take look at and recorded in an Excel sheet. The meta-analysis changed into accomplished the use of the Cochrane Collaboration's REVMAN software, model 5.4.

(i) CardioVascular Mortality:

CV Mortality was a dichotomous variable. Events and Totals were extracted for this and forest plot was generated. The overall effect was found to be 1.51 (0.31, 7.46). Two of the studies favoured experimental group while one study favoured the control group. The heterogeneity was found to be 62% (Figure 3).

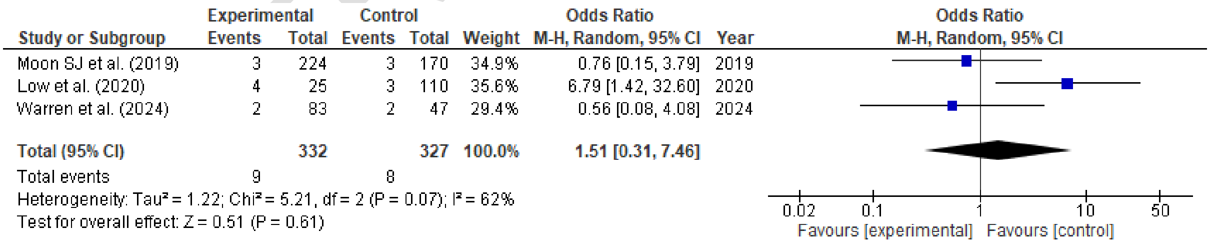

Figure 3: Forest Plot of Cardiovascular Mortality [17,21,22]

(ii) MACE:

Most adverse cardiac event was also used as a dichotomous variable. Events and Totals were extracted for this and forest plot was generated. Only one individual study favoured the experimental group while the other two were in favour of the control group. The overall effect was found to be 1.17 (0.48, 2.86). The overall heterogeneity was found to be 44% (Figure 4).

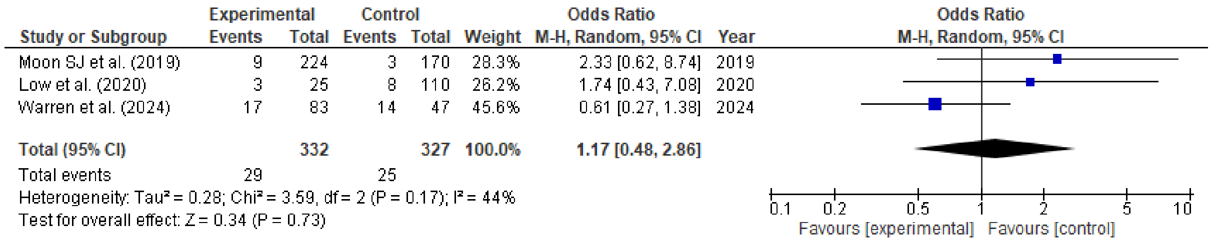

Figure 4: Forest Plot of MACE [17,21,22]

CASP Assessment:

To investigate the methodological satisfaction of the studies protected within the meta-analysis, the Critical Appraisal Skills Programme (CASP) device was used to generate a quality assessment table, called Table 4. Guyatt, Sackett, et al. The CASP standards in 1993, and the evaluation turned into based on a modified version of them [27].

Questions	**Moon SJ et al. (2019)**	**Limpijankit T et al. (2023)**	**Ng et al. (2020)**	**Kuznetsova et al. (2022)**	**Warren et al. (2024)**	**Low et al. (2020)**	**Cho et al. (2020)**	**Le et al. (2020)**	**Yoon et al. (2020)**	**Pickhardt et al. (2020)**
Is the research question concise?	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)
Were the right type of papers included in the study?	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)
Were all the important studies included in the design?	(Y)	(Y)	(?)	(Y)	(Y)	(Y)	(?)	(N)	(Y)	(Y)
Was the study quality evaluated appropriately?	(Y)	(?)	(N)	(N)	(Y)	(Y)	(?)	(N)	(N)	(Y)
Is the combination of study's results relevant?	(Y)	(Y)	(?)	(N)	(N)	(Y)	(N)	(N)	(Y)	(N)
Was the measure of heterogeneity and	(?)	(N)	(Y)	(N)	(N)	(Y)	(N)	(N)	(N)	(Y)

bias taken into account?										
Are the findings of study easy to interpret?	(Y)	(Y)	(Y)	(Y)	(N)	(?)	(Y)	(Y)	(Y)	(Y)
Are the results of the study appropriate?	(Y)	(?)	(Y)	(Y)	(N)	(N)	(N)	(Y)	(N)	(Y)
Is the study model verified?	(?)	(Y)	(?)	(N)	(Y)	(N)	(N)	(Y)	(N)	(Y)
Can this model be applicable to a smaller number of samples?	(N)	(?)	(?)	(N)	(Y)	(Y)	(N)	(Y)	(N)	(Y)
Are these findings in accordance with previous data?	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)
Score out of 11	8	7	6	6	7	8	4	7	6	10

Y = Yes N= No ? = Can’t tell

Table 4: CASP Analysis

DISCUSSION:

A overall of ten studies have been covered in this systematic evaluation and meta-analysis. All of the blanketed studies have been cohort research, either retrospective or potential. Meta-analysis changed into achieved for 2 variables: Cardiovascular Mortality and Major Adverse Cardiovascular Events (MACE). The effects indicated that the use of Coronary Computed Tomographic Angiography (CCTA) was related to advanced cardiovascular mortality consequences. Only one study reported the quantitative effect of CCTA on MACE. The studies showed that CCTA showed better long-term prognostic value for MACE than coronary artery calcium score in this asymptomatic older population [17]. CCTA has the potential to prevent CV events and provides helpful guidelines for the treatment of patients with stable CAD [18]. Of DM patients without symptoms (Framingham risk ≥20%), silent obstructive CAD was present in 20.6% of cases. Additionally, compared to normal volunteers, asymptomatic patients have a lower global MPRI [19]. The study emphasized the significance of taking age- and population-derived thresholds into account when grading LVDDF in individuals with high cardiovascular risk, as this improved risk assessment and outcome prediction [20]. A higher risk of long-term MACE among asymptomatic intermediate-risk patients is linked to the presence and burden of mixed plaque on CCTA, which is a better predictor than CAC score [21]. Early post-kidney transplantation detection of MI has good negative predictive values but poor positive predictive values. It also predicts long-term mortality, graft loss, and MACE in KTRs [22]. Despite a significant increase in its use, coronary CTA had a poor diagnostic yield for obstructive CAD, particularly in patients who were asymptomatic. It appears that the use of CTA in asymptomatic patients resulted in unsuitable follow-up diagnostic or treatment interventions that had no positive clinical outcome [23]. Exercise stress CMR shows diagnostic and prognostic potential in differentiating between physiological exercise-induced cardiac remodeling and pathological DCM in individuals with suspected DCM [24]. Using CCTA to assess the degree of stenosis and type of plaque, prognostic value over CACS and FRS was increased, improving risk stratification for stroke patients without a history of CAD [25].

A study by Perone showed that Even though cardiovascular imaging can improve the identification of cardiovascular threats in sufferers, it is frequently underestimated in number one and secondary prevention. Future research should examine how number one preventive strategies are laid low with cardiovascular imaging and the way polyvascular disorder detection can also result in more competitive scientific techniques for treating specific metabolic goals on this excessive-risk populace [28]. According to Cabrera's systematic review and meta-analysis, atherosclerosis is a low-grade, chronic inflammatory ailment that develops early in life. The chance of acute coronary occasions and clinical cardiovascular disorder (CVD) rises as the sickness worsens. This take a look at emphasizes how exceptional biomarkers, especially N-terminal pro b-type natriuretic peptide (NT-proBNP) and excessive-sensitivity C-reactive protein (hs-CRP), may be beneficial in enhancing the prediction of cardiovascular disorder risk in middle-aged individuals who are asymptomatic. However, earlier than those biomarkers can be advised for habitual scientific use, larger, greater thorough studies are required to offer conclusive proof [29].

The study has some strengths as well as some limitations. The strengths include low heterogeneity in the included studies. The quality of the included studies is also reassuring. There are also some limitations such as all of the included studies do not provide the quantitative data for the meta-analysis to be performed. Finally, a few research may not have followed sufferers for an extended time frame to decide how effective the treatments were.

CONCLUSION:

In conclusion, our systematic evaluation and meta-evaluation underscore the significant function of advanced imaging strategies, mainly coronary computed tomography angiography (CCTA), in predicting cardiovascular results in asymptomatic individuals. The findings strongly recommend that CCTA holds promise as a treasured device for hazard evaluation in this populace, presenting insights into the presence and quantity of coronary artery disorder (CAD) earlier than clinical signs occur. Moreover, our evaluation indicates a tangible improvement in cardiovascular mortality prediction with the incorporation of CCTA into hazard assessment protocols. These results underscore the capacity of CCTA to beautify early detection and intervention techniques, ultimately leading to better affected person results in asymptomatic people at risk of cardiovascular activities. However, further research, inclusive of longer-time period potential studies, is warranted to validate those findings and set up CCTA's definitive role in medical practice.

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