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Systematic Review

Prevalence, treatments and outcomes of coronary artery disease in Indians: A systematic review

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ABSTRACT

Aim: To conduct a systematic review on the prevalence, risk factors, treatments and outcomes of Coronary Artery Disease (CAD) in Indians.

Methods and results: We conducted a systematic review of studies in Indians with CAD from Jan 1969 to Oct 2012.

Initial search yielded 3885 studies and after review 288 observational studies were included. The prevalence of CAD in urban areas was 2.5%–12.6% and in rural areas, 1.4%–4.6%. The prevalence of risk factors was: smoking (8.9–40.5%), hypertension (13.1–36.9%) and diabetes mellitus (0.2–24.0%). The median time to reach hospital after an MI was 360 min. In hospital rates of drug use were: antiplatelets 68%–97.9%, beta blockers 47.3%–65.8% and ACEIs 27.8–56.8%.

Conclusions: In this first systematic review of CAD in India, prevalence of risk factors is high, treatments delayed and use of evidence based treatments variable.

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1. Introduction

The burden of cardio vascular disease (CVD) is on the rise globally. Cardiovascular deaths account for 30% of deaths world wide.[1] The burden of CVD is projected to be the highest in India by the year 2020, as compared to other countries.[2] In the WHO-PREMISE study, the proportion of coronary heart disease (CHD) among patients less than 50 years of age, was highest in India (22.6% in males and 3% in females).[3] In the Million Death Study (2009) the authors determined that cardiovascular diseases are the leading cause of death (20.3% in males and 16.9% in females) among Indian adults (age 25–69 years).[4] Yet it is difficult to get a comprehensive picture of the epidemiology and disease burden of coronary artery disease (CAD) in India. One systematic review of 31 studies in India reported that the prevalence of CAD is higher in urban as compared to the rural areas (Men 35–90/1000 vs. 17–45/1000; Women 28–93/1000 vs. 13–43/1000).[5]

In order to implement nation-wide policies to control CAD, we need a comprehensive view of its different aspects such as the disease burden, manifestations, treatment patterns and outcomes of the condition. We therefore conducted a systematic review of all the observational studies to record the available evidence on the epidemiology, risk factors, clinical presentations, management and outcomes of coronary artery disease among Indians residing in India.

2. Methods

A systematic review of all studies in Asian Indians with coronary artery disease addressing the epidemiology, risk factors, clinical presentations, management or outcomes of CAD among Indians.

2.1. Studies included

We included all studies from January 1969 to October 2012, pertaining to coronary artery disease and its treatments. The diagnosis of coronary artery disease was not uniform across different studies. The diagnosis was based on history of angina or myocardial infarction or electrocardiographic findings. Treatment of CAD included both prescribed drugs (in hospital based studies) and self-reported use of medications (in community based studies). We only included studies in English. As English is the primary medium of scientific communication in India, we are confident that we have been able to include all the relevant studies in this review. Amongst the studies that were excluded were: articles without original data (letters to the editor, comment and narrative review); studies conducted among Indians residing outside India and international studies without separate data on Indians.

2.2. Search strategy and data extraction

Two independent reviewers conducted a systematic search of Medline as well as extensive hand searches using the following pre-specified MeSH terms and search strategies: Search #1: Heart diseases OR myocardial ischemia OR coronary disease OR coronary artery disease OR coronary arteriosclerosis OR coronary atherosclerosis OR Ischemic Heart Disease; Search # 2: India OR Indians OR South Asia; and Search #3: combined #1 and # 2.

Duplicates were removed using Reference Manager (version 12). Relevant studies were selected for data extraction based on pre-specified eligibility criteria. Disagreements between the two reviewers on the selection of articles were resolved by discussions with a third reviewer.

We assessed study quality using parameters specified in the STROBE statement.[6] The parameters for different observational study designs were specified and are described here. For cohort studies we used indicators of eligibility criteria, source of cohort, methods of selection, and methods of follow up. The maximum score was 4 and minimum was 0. For case–control and cross-sectional studies the parameters included were as follows: eligibility criteria, ascertainment of cases and controls and the rationale for the choice of cases and controls. For cross sectional studies, eligibility specified, ascertainment of cases and rationale for inclusion of cases, were the parameters. The maximum score possible was 3 and the minimum was 0. Using a structured format, the following data were independently extracted: year, type of study, sample size, patient characteristics, incidence, prevalence, risk factors, manifestations, treatments and outcomes of CAD.

3. Results

The initial search yielded 3885 studies. Of these, a total of 111 studies were excluded as they were either studies with Indians combined with other South Asians (20) or studies conducted among Indians living outside India (91). We found 37 RCTs in our search and none of them looked at clinical outcomes. After removing duplicates and reviewing the title and abstract for relevance, 342 observational studies were identified. Fifty four of the 342 articles were editorials, letter to the editor, comment and did not contain original data. We extracted data from 288 observational studies (cohort 12 [4.2%], case control 57 [19.8%], cross sectional 180 [62.5%] and mixed methods 39 [13.5%]) (Fig. 1). Of these there were sufficient data in 59 studies for further analyses (Chi-squared and time trend analysis).

3.1. Quality of the studies included (Table 1)

Among the observational studies (288), we were able to assess the quality for 194 (68.3%) studies that had evaluable data. The data were insufficient to assess the quality in other studies. Of the 194 studies, 131 (67.5%) studies scored 2, and only 2 studies (1.0%) obtained the maximum score of 4.

3.2. Incidence and prevalence of CAD

There were two community based studies that had data on the incidence of CAD. The study by Chadha et al in 1993 conducted in urban Delhi included 4151 subjects (25–64 years of age) and followed up for 3 years, reported an incidence of CAD as 19.7/1000 (male 17.3 and female 21.0).[7] The study by

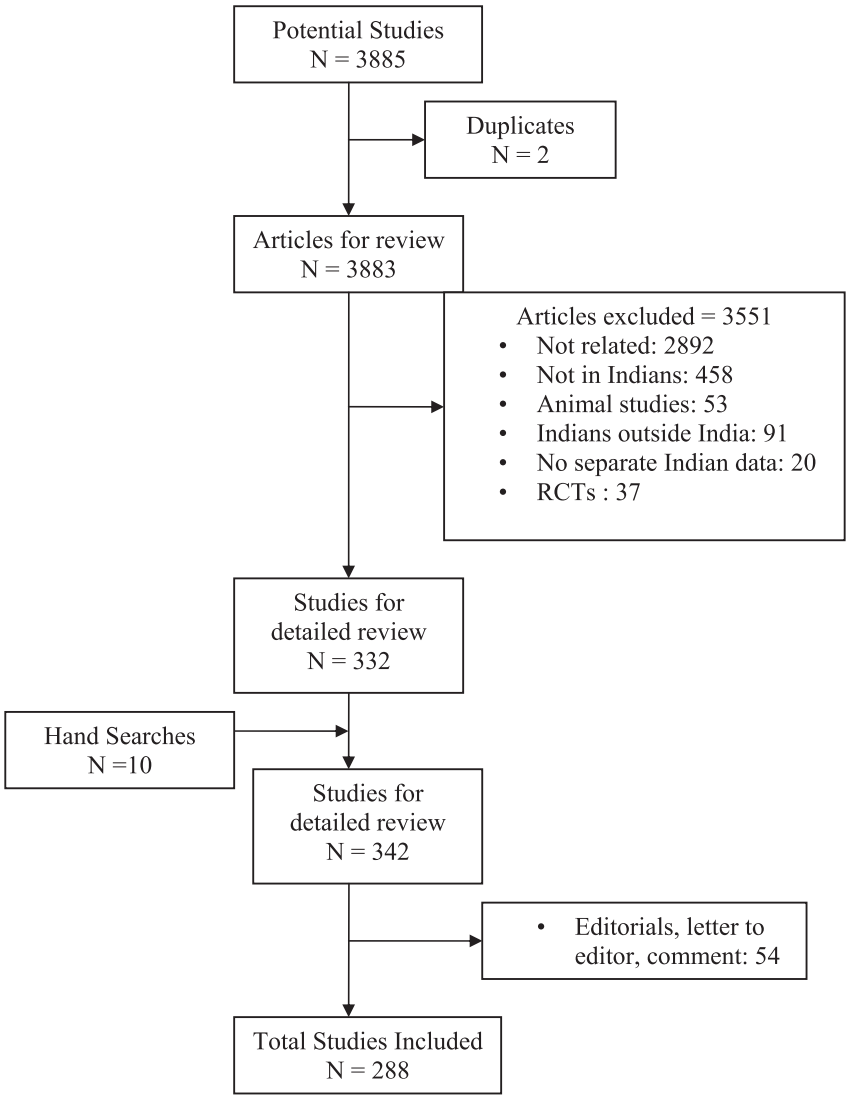

Fig. 1 – Flow chart of included studies.

Trivedi et al in rural population of Gujarat included 714 subjects (30–62 years of age), followed up for 5 years estimated the CAD incidence of 25.1/1000.[8]

There were 18 cross sectional studies conducted in various parts of India between 1990 and 2012. In 12 of these studies from urban areas among adults aged above 20 years (1990–2012, sample size [SS] from 534 to 13,723), the prevalence ranged from 2.5% to 12.6%. In 7 of these studies in rural areas (1993–2009, SS from 812 to 3148), the prevalence ranged from 1.4% to 4.6%. The prevalence of CAD among males in urban areas was 2.8 %–7.9% in 11 studies and 2.2%–15.8% among females in 9 studies (1990–2012). In rural areas the prevalence was 3.1%–6.9% in males and 1.7%–4.6% in females (1994–2009). There was a significant positive trend in the overall prevalence of CAD in urban (Mantel–Haenszel Chi squared value 299.99, $p < 0.0001$) and rural areas (Mantel–Haenszel Chi squared value 19.74, $p < 0.0001$). The diagnosis of CAD in these studies was not uniform. It was based on past history, ECG changes or the Rose questionnaire (Table 2). Prevalence of CAD as reported by ECG changes, were low: 5.2% in urban areas[9] and 3.1–4.4% in rural areas.[10–12]

Table 1 – Summary of Quality scores of Observational studies.

Quality score	Observational studies $n = 194$ (%)
4	2(1.03)
3	49(25.2)
2	131(67.5)
1	12(6.1)

3.3. *Risk factors (Table 3)*

The studies reporting the prevalence of risk factors were from 1976 to 2012. Hence the definition for each of the risk factors is different across various studies. The risk factor rates are thus reported as minimum to maximum percentages in this study. The prevalence of common risk factors in the community from cross sectional studies were as follows: hypercholesterolemia (7.0–30.0%; 10 studies 1994–2012), hypertension (13.1–36.9%; 12 studies 1993–2012) diabetes mellitus

Table 2 – Studies reporting prevalence of CHD and criteria for diagnosis by year.

Authors	Year	Place	S size	Age (yrs)	CHD %	Male	Female	[c]CHD diagnosis criteria
Urban (U)								
Chadha SL[38a]	1990	Delhi	13723	25–64	3.2	3.9	2.5	Clinical history
Chadha SL[39a]	1992	Delhi[a]	1317	25–64	2.5	2.8	2.2	Clinical history
Gupta R[9]	1995	Jaipur	2212	≥20	7.6	6.0	10.4	Past doc, Rose q or ECG changes
					5.2	3.5	8.4	Q, ST or T wave
[b]Gupta R[18]	1996	Rsthan	3397	NA	4.5	6.0-U	NA	Clinical history and ECG
						3.4-R		
RChdrn A[40a]	1998	Chennai	953	≥40	3.9	3.5	4.5	Clinical history or ECG (Q wave, ST changes)
Mohan V[41a]	2001	Chennai	1175	≥20	11	NA	NA	Clinical history or ECG (ST,T and Q changes
Gupta R[42a]	2002	Jaipur	1123	≥20	NA	6.2	10.1	Clinical history ± ECG (ST,T and Q changes)
Gupta R[43a]	2002	Rsthan	2212	>20	NA	7.1 H	10.4 H	Clinical history or ECG (ST and T changes)
						1.8 M	6.6 M	
D Prabhakaran[28]	2005	Delhi	2122	20–59	NA	7.3	NA	Clinical history or ECG (ST, T and Q changes)
Latheef SA[44a]	2007	Tirupathi	1519	>20	12.6	6.8	15.8	Clinical history & ECG (ST or Q wave changes or T changes)
				M 42.5 ± 9.4				
				F 38.8 ± 11.2				
[b]Kamili M[45a]	2007	Kashmiris	3128	≥40	7.5	7.9	6.6	Past doc, Rose q or ECG (ST and T changes)
					8.4 U			
					6.7 R			
Murthy PD[46a]	2012	AndraP	534	≥20	5.4	7.7	3.6	History or ECG (ST or Q wave changes)
Rural(R)								
Kutti VR[10]	1993	Tpuram	1130	>25	1.4	NA	NA	Definitive evidence of CHD
Gupta R[11]	1994	C Rsthan	1150	53 ± 4.6	4.6	4.6	4.6	Clinical history ± ECG ST and T wave changes ± Rose Q
Wander GS[12]	1994	Punjab	1100	>30	3.2	3.1	3.4	History, ECG and TMT
Gupta R[47a]	1997	Rsthan	3148	≥20	NA	3.4	3.7	Clinical + ECG (Q, ST or T changes)
Clara Chow[48a]	2007	AndraP	345	20–90	2.5	NA	NA	previous heart attack, stroke or angina
Rajeev B[49a]	2009	H Pradesh	812	>30	4.1	6.9	1.7	Hosp. records, TMT,ECG changes, Cor. Angiography

(Mantel–Haenszel Chi squared value for urban 299.99, $p < 0.0001$) (Mantel–Haenszel Chi squared value for Rural 19.74, $p < 0.0001$). NA: Not Available, H: Hindus, M: Muslims.
Rsthan – Rajasthan, C Rsthan – Central Rajasthan, Tpuram – Tiruvananthapuram, AndraP – Andhra Pradesh, H Pradesh – Himachal Pradesh.
Reference numbers 38a–49a are provided in the supplementary data.

[a] Gujaratis.

[b] Includes both urban and rural areas.

[c] Studies used different criteria for the diagnosis of CHD.

Table 3 – Prevalence (in %) of risk factors for CHD among community and patients from various studies.

Risk factors	Prevalence in community %	No. of studies	Prevalence in patients from CS studies	No. of studies
Hypercholesterolemia	7.0–30.0	9[9,12,28,44a,50a–53a,65a,66a]	15.0–46.2	6[43a,55a–58a,63a]
Decreased HDL	31.0–55.0	5[42a,44a,51a,53a,66a]	NA	
Increased TG	29.2–45.9	5[42a,44a,51a,53a,66a]	NA	
Increased LDL	–21.5–41.5	3[42a,53a,66a]	NA	
Smoking	8.9–40.5	8[9,10,12,28,47a,48a,52a,53a,65a,66a]	16.5–87.0	10[22,24,25,57a–59a,61a,63a,64a,67a]
Hypertension	13.1–36.9	11[10,12,28,42a,44a,47a,48a,51a–53a,65a,66a]	15.0–54.3	4[22,24,25,57a]
Diabetes	0.2–24.0	11[9,10,12,28,42a,44a,47a,48a,52a,53a,65a,66a]	5.0–44.6	5[22,24,25,57a,67a]
Positive family history	17.0–19.4	2[52a,54a]	8.0–40.0	3[57a,63a,68a]

NA: Not Available.
CS: Cross sectional.
Reference numbers 42a,44a,47a,48a,50-59a,61a,63a,67–68a are provided in the supplementary data.

(0.2–24.0%; 12 studies 1993–2012) and smoking (8.9–40.5%; 10 studies 1993–2012). Cross sectional studies among CAD patients report the prevalence of risk factors as follows: hypercholesterolemia 15.0–46.2% (6 studies 1970–2004), smoking 16.5–87.0% (10 studies 1987–2008), hypertension 15.0–54.3% (4 studies in 1987–2008) and diabetes mellitus 5.0–44.6% (5 studies 1987–2008). There was a significant positive trend with common risk factors like smoking, hypertension, diabetes mellitus and dyslipidemia in males and females when prevalence from studies with uniform definition of risk factors were analyzed. Mantel–Haenszel Chi squared values for males: Smoking 145.52, $p < 0.0001$, Hypertension 103.99, $p < 0.0001$, Diabetes mellitus 12.64, $p = 0.0004$, Dyslipidemia 161.09, $p < 0.0001$. Mantel–Haenszel Chi squared values for females: Smoking 35.84, $p < 0.0001$, Hypertension 35.59, $p < 0.0001$, Diabetes mellitus 11.19, $p = 0.0008$, Dyslipidemia 12.12, $p = 0.0005$ (Table 4).

Of the 55 case–control studies, the key risk factors (odds ratio) were, diabetes mellitus (2.7–8.9; 5 studies 1996–2008),[13–17] hypertension (2.0–4.6; 4 studies 1994–2005)[11,13,14,16] and smoking (1.3–4.4; 6 studies 1994–2005).[11,13–16,18] On the other hand vegetarianism (0.3; 1 study, 1996) and higher socioeconomic status (0.32 vs lower; 1 study 1996)[13] were found to be protective for CAD.

3.4. *Studies on acute coronary syndrome (ACS)*

We identified 19 studies on different aspects of acute coronary syndrome. The studies included 51,077 patients with myocardial infarction (minimum sample size [SS] 55[19] and maximum SS 25,748[20]) between 1972 and 2012.

3.5. *Presentation and treatment*

The mean age for the presentation of an acute myocardial infarction (AMI) ranged from 47 to 60 yrs in 6 studies. Anterior wall MI was the commonest presentation (50.5–71.7%, 3 studies, 1970–2008) and antero-inferior wall infarction was the least common (2.2–3.9%, 2 studies 2004–2008) (Table 5).

The time taken for onset of symptoms to reach hospital was reported to be over 24 h from a study conducted as early as 1972 (Gupta RN, SS 165).[21] This interval has considerably

Table 4 – Prevalence of major risk factors (%) for CAD in community from studies with similar definitions for risk factor.

Author	Year	Sample size	Age	Smoking		Hypertension		Diabetes		Dyslipidemia	
				M	F	M	F	M	F		
R Gupta[9]	1995	2212	≥20	39	19	30	34	NA	NA	NA	NA
R Gupta[47a]	1997	3148	≥20	51	5	24	17	NA	NA	NA	NA
Reddy N K[52a]	2002	3307	43.12 ± 9.5	27	2	28	19	26	9	59	45
R Gupta[53a]	2003	1123	NA	40.5	20.5	33.7	33.7	7.8	7.3	37.4	43.1
R Gupta[65a]	2007	1127	≥20	37	2.1	57.9	48.9	25.9	21.1	32.6	39.5
R Gupta[66a]	2012	739	20–59	21.1	4.2	39.5	24.6	15.5	10.8	33	32.7

NA: Not Available.
Reference numbers 47a, 52-53a, 65–66a are provided in the supplementary data.
Definitions of the risk factors.
Smoking: Users of all types of tobacco products and present & past smokers are included in studies 53a, 65a and 66a. Other studies do not mention the definitions.
Hypertension: Blood pressure of >140/90 was considered as hypertension. Diabetes mellitus: Past history or fasting blood sugar level of >126 mg %.
Dyslipidemia: Total blood cholesterol levels ≥200 mg/dl.
Mantel–Haenszel Chi squared values for males: Smoking 145.52, $p < 0.0001$, Hypertension 103.99, $p < 0.0001$, Diabetes mellitus 12.64, $p = 0.0004$, Dyslipidemia 161.09, $p < 0.0001$.
Mantel–Haenszel Chi squared values for females: Smoking 35.84, $p < 0.0001$, Hypertension 35.59, $p < 0.0001$, Diabetes mellitus 11.19, $p = 0.0008$, Dyslipidemia 12.12, $p = 0.0005$.

Table 5 – Data reporting the involvement and location of myocardial wall in patients with myocardial infarction.

Myocardial wall	Percentage of patients
Anterior wall MI[55a,24,25]	50.5%–71.7%
Inferior wall MI[24,25]	39.1%–47.3%
Ass. right ventricular or Posterior wall MI[55a,24,25]	13.3 %–62.7%
Antero-inferior wall MI[24,25]	2.2%–3.9%

Reference number 55a is provided in the supplementary data.

Table 6 – Symptoms to hospital and door to needle time in the treatment of acute myocardial infarction.

Study	Sample	Time to hospital	Door to needle
Gupta RN 1972[21]	165	24 H to 7 D	NM
Gupta SP 1981[69a]	158	4 H 55 min	NM
Chopra KL 1990[23]	330	NM	210 ± 64 min.
Anand SS 1997[70a]	87	330(50–5760)min	30 (17–100) min
Malhotra S 2003[71a]	104	8.5 ± 0.8 H	1.2 ± 0.1 H
Jose VJ 2004[25]	1320	10.8 ± 12.4 h	NM
Achari V 2008[24]	862	29.2 ± 10.8 H	NM
Xavier D 2008[22]	20,468	360 min	50 (25–68) min

NM: Not Mentioned, H: hours, D: days.
Reference numbers 69a-71a are provided in the supplementary data.

decreased in recent studies to a median of 360 min (Xavier D 2008, SS 20,468).[22] The door to needle time also has decreased over time from 210 min (Chopra KL 1990, SS 330)[23] to 50 min (Xavier D 2008, SS 20,468).[22] Table 6.

Drug use in acute MI was reported since 1997 in 6 studies. They included thrombolytics 24.7–73.0%, antiplatelets 68.0–97.9%, beta blockers 47.3–65.8%, angiotensin-converting enzyme inhibitors (ACEI) 27.8–56.8%, nitrates 59.0–86.6% and anticoagulants 70.0–81.3% (Table 7). The rates of percutaneous coronary intervention (PCI) were as follows: overall rates 7.5–11.9%[20,22] and in STEMI patients 1.4–12.9%.[20,22,24]

3.6. *Outcomes (Table 8)*

Our systematic review identified 8 studies from 1972 to 2012 with data on clinical outcomes in patients with MI. The earliest study[21](Gupta RN 1972, SS 165) reported a 13.8% in-hospital mortality and a 2012 study reported 3.9%.[20] Studies in patients with STEMI reported all cause mortality of 16.9%[24] in 2004 and 8.2% in 2012.[20] D Xavier et al in a large study reported the following rates of outcomes: death 6.7%, reinfarction 1.9% and stroke 0.5% at the end of one month after AMI.[22]

Table 7 – In-hospital and post discharge drug use in patients with MI.

Drug	Utilization in %	Year
Thrombolytics[22,24,67a,70a,72a,20]	24.7–73	1997–2012
Beta blockers[22,70a,72a,20]	47.3–65.8	1997–2012
ACE inhibitors[22,70a,72a,20]	27.8–56.8	1997–2012
Aspirin[22,70a,72a,20]	68.0–97.9	1997–2012
Nitrates[70a,20]	59.0–86.6	1997,2012
Anticoagulants[22,70a,20]	70.0–81.3	1997,2012

Reference numbers 67a,70a and 72a are provided in the supplementary data.

3.7. *Secondary prevention of CAD*

There were 4 studies that reported the drug utilization in secondary prevention of CAD from 2005 to 2009. Three of these studies reported drug utilization in outpatients while the fourth was a survey in the community. The use of aspirin 82.5–94.5% vs. 14.0% and statins 38.4–69.0% vs. 5.0% was higher among outpatients as compared to that in the community. The use of beta blockers ranged from 48.1 to 69.0% and ACE inhibitors or ARBs 15.5–82.0% in outpatients (Table 9).

4. Discussion

In a comprehensive systematic review of CAD studies from India published over 40 years, we reviewed 288 studies that fulfilled the criteria for inclusion. Multinational studies including patients from India but not reporting separate data on Indians were not included.

We used the STROBE criteria to assess quality of the studies. Overall the quality of the studies was poor. About two-thirds of the observational studies had a score of 2 and just 1.0% obtained a maximum score of 4.

We identified only 2 community based studies that reported the incidence of CAD. Chadha (1985–87)[7] reported an annual incidence of 19.7/1000 over 3 years, and Trivedi[8] (1987–92) reported 25.1/1000 over 5 years. These studies were done in 2 regions (Delhi and Gujarat) and thus the findings may not be applicable to the entire country.

We identified 18 studies on the prevalence of CAD (11 urban, 6 rural and 1 in both areas) conducted over 22 years (1990–2012). During this time period, we note an increase in the prevalence of CAD, both in urban (3.2% in 1990 to 12.6% in 2007) and rural areas (1.4% in 1993 to 4.0% in 2009). The increase is seen in both males and females. Even though there is an increased prevalence of CAD over the years, this data has limitations as all these studies were confined to single regions and none representative of the country. On comparison of this prevalence data with the reports from US and the UK, we found that rates are lower than those reported in Indian studies. The American Heart Association Statistics Committee and Stroke Statistics Subcommittee reports an overall prevalence of CHD in the US as 7.9% (9.1% in males and 7.0% in females) in 2006.[26] In England, the British Heart Foundation reported a prevalence of 6.5% in males and 4.0% in females in 2006.[27] The mean age of patients with MI in India is also lower. The studies reported the age ranging from 55.0 to 58.2 years in males and 55.7–60 years in females. The US studies reported an average age of the first MI of 65.8 for men and 70.4 years for women.[26]

The common risk factors identified were smoking, hypercholesterolemia, hypertension and diabetes. Even though the studies are not representative of the country, we note an increase in the prevalence of these risk factors in the community from 1993[10] to 2005.[28]

Table 8 – Outcomes reported among AMI patients.

Study	Year	S size	Outcome	In hospital	30 day	6–36 months
Gupta RN[21]	1972	165	All cause mortality	13.8%	NM	NM
Chopra KL[23]	1990	330	Mortality	4.8%	NM	NM
			Reinfarction	NM	NM	4.0%
			Late mortality	NM	NM	1.8%
E. George[72a]	1999	1072	Death	13.6%	NM	NM
			Cardiac failure	15.5%	NM	NM
			Reinfarction	11.4%	NM	NM
			II/III degree block	9.2%	NM	NM
			Arrhythmia	7.2%	NM	NM
Kaul U[19]	2002	57	Composite of death, MI or revascularization	NM	12.7%	NM
[a]Jose VJ[25]	2004	1320	Mortality	16.9%	NM	NM
			Composite of death, MI, Recurrent angina	NM	18.8%	NM
Xavier D[22]	2008	20468	Death	NM	6.7%	NM
			Reinfarction	NM	1.9%	
			Stroke	NM	0.5%	
[a] Achari V[24]	2008	862	Mortality	12.4	NM	NM
PP Mohanan[20]	2012	25748	Death	3.9	NM	NM
			Reinfarction	0.5	NM	
			Stroke	0.3	NM	

NM: Not Mentioned.
Reference number 72a is provided in the supplementary data.
[a] Studies included only patients with STEMI.

Between 1993 and 2005 we see an increase in the prevalence of smoking in communities from 21.9 to 36.0%. The European Heart Survey (EHS)[29] reported a prevalence of tobacco smoking of 29.4% in 2004 for the European Region and Heart and Strokes updates 2010 reports 20.6% in 2008 in the US.[30] The prevalence rate of smoking in India is higher, even in comparison with data from a developing country like the Republic of Seychelles (17.5%).[31] Prevalence of hypercholesterolemia (30%, Prabhakaran D 2005) among Indians was higher compared to Seychelles (24.2%) but lower compared to 46.8% in the US.[30] Hypertension (30.0%) among Indians was lower as compared to reports from other regions (39.6% in Seychelles 2004, 33.6% in the US). The prevalence of diabetes mellitus has not only increased almost 4 folds over 12 years in India (4–15%, 1993–2005) but also is higher as compared to other regions (9.3% in Seychelles in 2004 and 7.7% in the US 2006).

Table 9 – Drug use for secondary prevention of CAD.

Study	Year	S size	Drugs	% Patients (CI)
Mendis S[3]	2005	1013	Aspirin	94.5%
Bulletin			Beta blockers	48.1%
of WHO			ACEI	41.3%
(PREMISE)			Statins	38.4%
Gupta R[73a]	2009	406	Aspirin	82.5% (78.2–86.2)
Outpatients			Beta Blockers	53% (48.1–57.9)
			ACEI	15.55 (12–19)
			Statins	69% (61–77)
Joshi R[74a]	2009	4535	Aspirin	14%(10–18)
≥30 yrs			BP lowering	41%(36–47)
Community			Lipid lowering	5%(3–7)
survey				
Sharma K[75a]	2009	2993	Aspirin	91%
Stable CAD			Beta Blockers	69%
patients			ACEI/ARBs	82%
			Statins	69%

Reference numbers 73–75a are provided in the supplementary data.

The data from patients with CAD, as reported in a recent study (Xavier D 2008), showed a higher prevalence of smoking (40.2%) and diabetes mellitus (30.4%) as compared to Euro Aspire III (smoking 17.0% and 25.0% diabetes) while the prevalence of hypertension is lower (37.7% vs. 56.0%).[32]

In patients with MI, the time from onset of symptoms to reach the hospital and door to needle has reduced considerably over the years (1972–2008) from 24 h[21] to 6 h[22] and from 210[23] to 50 min[22] respectively. These intervals are still longer as compared to recent reports from other countries (170 min and 40 min in European Heart Survey 1, 2002,[33] 145 min and 37 min in EHS 2, 2004[34] and 139 min in STEMI and 191 min in NSTEMI patients in GRACE registry 2002[35]).

The utilization of drugs among CAD patients in hospital was reported in 6 studies. The use of antiplatelets was good (68.0–97.9%) whereas the use of other drugs like beta blockers 47.3–65.8% and ACEIs 27.8–56.8% were low in India when compared to other countries (beta blockers 81.0%, ACEIs 66.0%).[35]

The utilization of drugs for secondary prevention is also low in India. A study at the community level (Joshi R, 2009) reports utilization of aspirin at 14.0% and lipid lowering drugs at 5.0% for secondary prevention. This is low as compared to the overall rates of drug use among patients with CHD from the PURE study[36] (antiplatelets 25.8% and statins 16.7%). PURE study also reports low rates of drug use in participants from low income countries which include India (antiplatelet drugs 11.0%, ACE inhibitors or ARBs 6.5% and statins 4.5%).

There were very few studies with data on outcomes in patients with MI. In-hospital mortality after MI has decreased

from 13.3% in 1972, 13.6% in 1999 to 3.9% in 2012. Mortality in STEMI patients was reported to be 12.4% in 2008[24] which decreased to 8.2% in 2012.[20] The mortality rates have reduced over the years, but studies from developed countries report lower mortality rates. A follow up of the patients in the GRACE registry reported a decline in hospital mortality from 8.4% in 1999 to 4.6% in 2005.[37]

There are limitations in our systematic review. The search was limited to PubMed. There is therefore a possibility that we missed identifying some studies. Though 288 observational studies were reviewed, collation and analysis of data could be conducted only from 59 studies. This is because data from other studies were either incomplete or were primarily from patients with other conditions (eg. diabetes, rheumatic heart disease etc.) with only a mention of CAD. Even though these studies looked at various aspects of CAD, the objectives and the patient population included were different in each study.

5. Conclusions

This is the first systematic review of CAD in India that is comprehensive and covers a wide range of issues. We have found that single centre and regional studies report a high prevalence of CAD and high rates of risk factors. Patients take a long time to get to hospital, treatment for ACS is delayed, in-hospital use of evidence-based treatments is variable and post discharge rates of drug use are low. Hospital and short term mortality rates in ACS patients are high in observational studies. There are only a few high quality studies, and none representative of the country. There are no long-term studies to inform chronic management of CAD. Therefore to counter the burgeoning epidemic of CAD in India, we urgently need high quality, representative and long term studies addressing different issues. These studies should lead to programs for the reduction of risk factors and improved treatments to reduce the burden of CAD in India.

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Conflicts of interest

Possible conflicts of interest (including financial and other relationships) for each author include the following: Drs. Xavier, Pais and Sigamani have received research funds from AstraZeneca, India. Dr. Pais has received consultancy fees from AstraZeneca. All three of them received these funds in to the Institution (St. John's) account. Other authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ihj.2015.05.003.

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