

Epidemiological study on cardiac emergencies in Indian states having GVK Emergency Management and Research Institute services

G. V. Ramana Rao, H. V. Rajanarsing Rao¹, G. Kesav Reddy¹, M. N. V. Prasad²

Emergency Medicine Learning Centre (EMLC) & Research, GVK Emergency Management and Research Institute, Devar Yamzal, Medchal Road, Secunderabad, Telangana, ¹Emergency Medicine Learning Centre (EMLC) GVK Emergency Management and Research Institute, Devar Yamzal, Medchal Road, Secunderabad, Telangana, ²Analytics GVK Emergency Management and Research Institute, Basaveshwarnagar Entrance, Magadi Road, Bangalore, Karnataka, India

ABSTRACT

Background: Emergency medical service (EMS) is critical for the healthcare system as it saves lives by providing care immediately. Rapid access to medical care after a major cardiovascular event decreases morbidity and mortality. GVK Emergency Management and Research Institute (GVK EMRI) is a pioneer in emergency management services operated as a public private partnership (PPP) with various state governments. GVK EMRI coordinates medical, fire, and police-related emergencies through a single toll-free number, 108, across 15 states and 2 union territories of India. **Material and Methods:** This is a retrospective study of reported cases of cardiac emergencies in 2015 across 11 states with GVK EMRI services: Andhra Pradesh, Telangana, Assam, Goa, Gujarat, Karnataka, Madhya Pradesh, Meghalaya, Rajasthan, Tamil Nadu and Uttarakhand. Descriptive statistics using frequencies, proportions and means were calculated. **Results and Discussion:** This study aimed to describe the epidemiology of cardiac emergencies presenting to GVK EMRI across 11 states in India in 2015. There were increased cases of cardiac emergencies reported by higher age group individual across all states. The mean age was reported between 43 years to 62 years across the states. In this study, men called EMS for cardiac emergencies more often than women, except in the state of Gujarat. A higher number of cardiac emergency cases were reported by individuals living below the poverty line in Andhra Pradesh, Telangana, Assam, and Goa. Often (82.8%) people called 108 greater than six hours of symptom onset. Variation in call volume per day was minimal between the days of the week. At 48 hours, there were 2,675 reported deaths (1.1%). **Conclusions:** The current study stresses the scale and seriousness of the emerging challenge of cardiac emergencies, with particular emphasis on socioeconomic deprived groups in the operated states of GVK EMRI.

Key words: Emergency medical services (EMS), cardiac emergencies, cardiovascular disease (CVD)

INTRODUCTION

It is estimated that by 2020, cardiovascular disease (CVD) will be the largest cause of disability and death in India. The country already has more than 118 million people with

hypertension, which is expected to increase to 213 million by 2025.^[1-3] Within CVD, coronary heart disease (CHD) and congestive heart failure are major contributors to

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Ramana Rao GV, Rajanarsing Rao HV, Reddy GK, Prasad M. Epidemiological study on cardiac emergencies in Indian states having GVK Emergency Management and Research Institute services. J Soc Health Diabetes 2016;4:121-6.

Access this article online	
Quick Response Code:	Website: www.joshd.net
	DOI: 10.4103/2321-0656.187999

Corresponding Author: Dr. G.V. Ramana Rao, Director, Emergency Medicine Learning Centre (EMLC) & Research, GVK Emergency Management and Research Institute, Devar Yamzal, Medchal Road, Secunderabad-500 014, Telangana, India. E-mail: ramanarao_gv@emri.in

the disease burden. CHD has led to an estimated 23% of deaths across all age ranges and 32% of adult deaths from 2010 to 2013.^[4] In 2010, it was the leading cause of disability-adjusted life years worldwide (up from fourth in 1990 and increased by 29%).^[5]

Cardiac emergency conditions are life-threatening situations that need immediate identification, and delays in the management could lead to morbidity or mortality. Patients with cardiac emergencies may present in a variety of ways, including hypotension or severe hypertension, chest pain, abnormal cardiac rhythms, or cardiac arrest. Specifically, acute coronary syndrome refers to any group of clinical symptoms compatible with acute myocardial ischemia and includes unstable angina, non-ST-segment elevation myocardial infarction, and ST-segment elevation myocardial infarction. These high-risk manifestations of coronary atherosclerosis are the important causes of the use of emergency medical care and hospitalization.^[6]

In addition, cardiac arrhythmias, such as bradycardia (heart rate <50/min) and tachycardia (heart rate >100/min), require rapid therapeutic intervention. Myocarditis is an acute infectious or immunologic syndrome that is uncommon but can be devastating with limb-threatening and life-threatening potential. Clinically, patients may present with fulminant myocarditis, manifested by cardiogenic shock.

Chest pain is a common symptom among patients contacting emergency medical service (EMS). Risk stratification of these patients is warranted before arrival to the hospital regarding likelihood of an acute life-threatening condition (LTC). There is strong evidence for an increased risk of an acute LTC with increasing age, male gender, elevated heart rate, low systolic blood pressure, and ST elevation or ST depression on a 12-lead electrocardiogram.^[7]

EMSs are an essential part of the overall healthcare system as it saves lives by providing care immediately. These services are not limited to actual in-hospital treatment, from hospital arrival to stabilization but include prehospital care and transportation.^[8] The World Health Organization regards EMS systems as an integral part of any effective and functional healthcare system.^[9] It is the first point of contact for the majority of people to healthcare services during emergencies and life-threatening injuries and can connect people to necessary secondary and tertiary healthcare services.^[10,11] India faces a growing number of emergencies amenable to EMS care and requires a stronger EMS system.^[12]

GVK Emergency Management and Research Institute (GVK EMRI) has been providing comprehensive emergency services, in partnership with various state governments, by running a single toll-free number 108 in 17 states and union territories across India.^[13] The aim of this study is to describe the epidemiology of suspected cardiac emergencies presenting to GVK EMRI across 11 states in India in 2015.

MATERIALS AND METHODS

This study is a retrospective study of reported cases of cardiac emergencies in 2015 across 11 states with GVK EMRI services: Andhra Pradesh, Telangana, Assam, Goa, Gujarat, Karnataka, Madhya Pradesh, Meghalaya, Rajasthan, Tamil Nadu, and Uttarakhand.

Data were collated from three sources. First, data are collected via emergency response officers in each state's central call center and stored as computer telephonic integrity (CTI) data. CTI data contain patient demographics, location, and contact information. Second, prehospital care records (PCRs) are forms filled out by EMTs after a patient has been transported to a hospital. PCRs contain information on operational characteristics, including distances travel, time per distance traveled, patient characteristics, prehospital care provided, and hospital to which the patient was transported. Third, GVK EMRI strives to complete 48-h follow-up on all patients who use transport services. All of these data sources (CTI, PCR, 48-h follow-up) are linked by a single incident ID.

All calls categorized as "cardiac emergency" or "chest pain" by the emergency response officer after speaking with the patient were included in this study.

Around 248,828 reported cardiac emergency cases were selected for the study.

We reviewed calls for age, gender, social status, economic status, total time from call to hospital arrival, response time (time from EMS dispatch to ambulance arrival at scene), hospital admission, and 48 h mortality or status, if alive. A patient's status at 48 h was categorized as "alright and discharged from hospital;" "stable, out of danger but still in the hospital;" "critical and still in the hospital;" or "expired." Descriptive statistics using frequencies, proportions, and means were calculated.

RESULTS

In 2015, there were 248,828 cardiac emergency cases across these 11 states of GVK EMRI. The reported pattern

Table 1: Percent distribution of reported cardiovascular disease emergencies by type of ambulance, ERCP advice, case closing management, and victim's status after 48 follow-up, GVK Emergency Management and Research Institute operated states in India

Characteristics	Andhra Pradesh	Andhra Pradesh	Telangana	Telangana	Assam	Assam	Goa	Goa	Gujarat	Gujarat	Karnataka	Karnataka	Madhya Pradesh	Madhya Pradesh	Meghalaya	Meghalaya	Rajasthan	Rajasthan	Tamil Nadu	Tamil Nadu	Uttarakhand	Uttarakhand
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Age group	18,579	6531	18,530	2575	45,500	41,917	25,525	347	15,785	58,703	3733											
0-17	411	3	1585	75	2	1257	4	9	7	3	31	4	1115	7	1499	3	151	6	3565	6	303	8
18-27	1326	10	1510	182	10	3436	8	16	10	8	57	11	1006	6	3565	11	390	11	6356	11	390	10
28-37	2077	15	1683	284	13	4724	11	14	17	13	40	13	1680	18	11061	19	598	18	11061	19	598	16
38-47	3109	17	3261	412	17	6762	16	19	20	17	59	17	2831	20	14596	25	786	20	14596	25	786	21
48-57	3901	21	4549	394	15	8658	21	20	20	15	110	32	3178	38	21626	37	1505	38	21626	37	1505	40
58+	7755	37	5942	1228	38	17080	41	33	38	33	45	48	5975	43		62		43				
Mean age (in years)	47		46	53	50	45																
Gender	18,579	6531	18,530	2746	45,574	41,917	26,431	348	14,993	58,703	3681											
Male	10,661	56	10,750	1612	59	25,310	60	60	42	60	197	0	11,259	75	35,258	60	2249	75	35,258	60	2249	61
Female	7918	44	7780	1134	41	16,607	40	10,614	58	16,607	151	15,817	3734	25	23,445	40	1432	25	23,445	40	1432	39
Social status	18,520	6473	18,530	2592	45,458	41,917	25,525	313	14,993	58,703	3583											
SC	5608	30	1762	34	1	6947	17	4	6	17	12	NA	NA	NA	20,524	35	601	NA	20,524	35	601	17
ST	1024	6	1896	10	6	2718	6	30	30	6	264	NA	NA	NA	570	1	69	NA	570	1	69	2
BC	7932	43	4832	368	14	15,909	38	40	40	38	2	NA	NA	NA	36,767	63	273	NA	36,767	63	273	8
OC	3956	21	10,040	54	2022	16,343	39	24	24	16,343	35	NA	NA	NA	842	1	2640	NA	842	1	2640	74
Economic status	18,375	6377	18,530	2605	45,385	41,917	26,431	342	14,993	58,703	3250											
Below poverty line (white card)	17,872	95	14,525	78	1668	64	21,549	47	47	6830	16	NA	NA	NA	0	0	1032	NA	0	0	1032	32
Above poverty line (pink card)	503	323	4005	937	36	35,087	84	NA	53	35,087	84	NA	NA	NA	58,703	100	2218	NA	58,703	100	2218	68
Call time (h)	21,079	7297	18,530	2634	46,157	41,917	23,728	346	15,785	58,703	3733											
0-6	4348	21	1701	506	19	6833	16	18	18	6833	16	3715	1080	7	12,381	21	751	7	12,381	21	751	20
6-12	5778	27	5754	688	26	9856	24	29	29	9856	24	6553	5216	33	17,770	30	1012	33	17,770	30	1012	27
12-18	5297	25	5729	739	28	12,331	29	31	31	12,331	29	5786	4898	31	13,374	23	966	31	13,374	23	966	26
18-23	5656	27	5346	701	27	12,897	31	22	22	12,897	31	7674	4591	29	15,178	26	1004	29	15,178	26	1004	27
Weekday	21,079	7297	18,530	2765	46,157	41,917	23,728	350	15,785	58,703	3733											
Sunday	2839	13	3005	393	14	5774	14	14	14	5774	14	NA	2101	13	7844	13	498	13	7844	13	498	13
Monday	3199	15	2382	391	14	6108	15	14	14	6108	15	NA	2302	15	8711	15	517	15	8711	15	517	14
Tuesday	3060	15	3083	398	14	5773	14	14	14	5773	14	NA	2258	14	8317	14	561	14	8317	14	561	15
Wednesday	2997	14	2741	392	14	6035	14	14	14	6035	14	NA	2299	14	8639	15	552	14	8639	15	552	15
Thursday	2987	14	2414	380	14	6102	15	15	15	6102	15	NA	2280	15	8569	15	526	15	8569	15	526	14
Friday	3036	14	2367	401	15	6002	14	14	14	6002	14	NA	2280	14	8341	14	519	14	8341	14	519	14
Saturday	2961	14	2538	410	15	6123	15	15	14	6123	15	NA	2278	14	8282	14	560	14	8282	14	560	15
Response time (in min)	1202	1187	18,531	2765	46,157	41,917	25,176	350	15,785	58,703	3733											
0-8	231	19	759	992	36	11,129	27	21	28	11,129	27	4413	2058	13	15,596	27	1013	13	15,596	27	1013	27
9-15	19	2	2449	733	27	8737	21	33	33	8737	21	3836	2189	14	12,582	21	684	14	12,582	21	684	18
16+	952	79	15,323	1040	38	22,051	53	39	39	22,051	53	16,927	11,538	73	30,525	52	2036	73	30,525	52	2036	55
Mean response time	18		32	15	16	17				34			28		20		35		20		35	
ERCP advice (in min)	21,079	7297	18,530	2765	46,157	41,917	25,176	350	15,785	58,703	3733											
Yes	9554	45	730	700	25	28,113	61	61	61	28,113	61	3118	NA	NA	27,381	47	2032	NA	27,381	47	2032	54
No	11,525	55	17,800	2065	75	18,044	39	39	39	18,044	39	22,745	NA	NA	31,322	53	1701	NA	31,322	53	1701	46
Case closing management-availed cases	15,778	6103	17,428	1925	44,608	39,662	24,983	147	15,103	29,626	3027											

Contd..

Table 1: Contd...

Characteristics	Andhra Pradesh	Andhra Pradesh (%)	Telangana	Telangana (%)	Assam	Assam (%)	Goa	Goa (%)	Gujarat	Gujarat (%)	Karnataka	Karnataka (%)	Madhya Pradesh	Madhya Pradesh (%)	Meghalaya	Meghalaya (%)	Rajasthan	Rajasthan (%)	Tamil Nadu	Tamil Nadu (%)	Uttarakhand	Uttarakhand (%)
Closed (victim admitted at hospital)	14,241	90	5657	93	16,97	97	1814	94	43,061	97	37,684	95	23,962	96	143	97	14,941	99	26,697	90	2972	98
Closed first aid (EMT gave first aid to the victim)	168	1	71	1	330	2	62	3	118	0	1181	3	723	3	1	1	43	0	98	0	48	2
Victim expired (before ambulance reached the spot)	1369	9	375	6	181	1	49	3	1429	3	797	2	298	1	3	2	119	1	2831	10	7	0
Victims status after 48 h follow-up	Total	19,527	6823	1102	807	46,157	4399	50	296	23,160	3405											
All right and discharged from the hospital	1511	8	959	14	0	690	86	25,993	56	1283	29	0	0	137	46	NA	NA	23,160	100	757	22	
Expired	342	2	183	3	0	114	14	1615	3	320	7	0	0	31	10	NA	NA	NA	NA	70	2	
Not categorized	17,674	91	5681	83	1102	100	3	0	18,549	40	2796	64	50	100	128	43	NA	NA	NA	NA	2578	76
Total availed cardiac cases	20,972	13,039	18,586	2763	46,490	41,917	26,446	378	15,798	58,703	3736											
Case closing management-unavalled cases	Total	292	301	83	0	305	425	237	0	505	64											
Victim already shifted	266	91	268	89	83	100	NA	NA	305	100	389	92	191	81	0	NA	5.01	99	1551	99	64	100
Hoax call	26	9	33	11	0	0	NA	NA	0	0	36	8	46	19	0	NA	4	1	21	1	0	0

The number of cases is shown in the table as per the reported cases of the parameters. NA: Data not available, SC: Schedule caste, ST: Schedule tribe, OC: Other caste, EMTs: Emergency medical technicians, ERCP: Emergency response centre physician

of cardiac emergency cases varied by the state was not proportional to individual state size. Sociodemographic analysis [Table 1] showed a mean age of 50 years for the entire study population. However, there was a considerable range in mean age by state (from Tamil Nadu: 43 years to Uttarakhand: 62 years). Many patients (37.7%) were older than 58 years. Over half of patients were men (57.1%), except in Gujarat (42% men). Almost half of patients lived below the poverty level (46.4%).

More number of cases was reported to GVK EMRI and sought 108 EMS services in after 6 h in the operated states. The variation observed among the week days was minimal as far as the number of cases being reported for medical emergency services.

We were unable to calculate response times for 13.4% of the records ($n = 33,322$). Of the remaining records, the response time was defined as the interval of the notification for the emergency ambulance service and arrival of the ambulance at the victim's location. A good number of victims were provided the emergency service with response time of <8 min and response time was under 8 min in 22.8% of cases ($n = 49,168$). However, lower mean response time (in minutes) was observed in Goa and Gujarat as 15 and 16 min, respectively. Mean response times by state ranged from 15 min in Goa to 32 min in Assam.

Only 17.2% ($n = 41,312$) of patients called within 6 h of symptom onset. There were 7458 cases of patients who died before the ambulance arrived (3.0%), with some states having much higher rates: Tamil Nadu 2831 (10%) and Andhra Pradesh 1369 (9%). The follow-up rate at 48 h was 45.5% and varied greatly between states (1% and 93%). At 48 h, there were 2675 reported deaths (1.1%).

DISCUSSION

The present study reported on epidemiological profile of reported cardiac emergencies in 11 GVK EMRI operated states of India. CVD, especially CHD, is epidemic in India and India must have the critical prehospital EMS infrastructure to respond to cardiac emergencies from CVD.

In this study, patients over the age of 58 years represented the highest volume of cardiac emergencies compared to other age groups. The mean age for all states was 52 years, which is similar to literature reporting the mean age for initial presentation of acute myocardial infarction in Indians as 53 years.^[14] One limitation of this study is that we do not have a final diagnosis for patients using 108

for cardiac emergencies. Therefore, we do not know what proportion of these calls is for acute myocardial infarction.

Gender differences have been reported in earlier studies as an established risk factor for CHD, with reports of higher incidence among men than women.^[15-20] The present study also found that calls for cardiac emergencies were predominantly for men. However, this may be confounded by a greater likelihood of men to use EMS for any chief complaint. Further research will need to investigate gender differences in the use of EMS and compare this to the cardiac emergency population.

The relationship of socioeconomic status to CVD is changing as the epidemic evolves.^[21] The current research shows that socioeconomically disadvantaged individuals now carry the dominant burden of CVD and its associated risk factors.^[22-25] In this study, most of the callers were from a poorer socioeconomic, rural background, and/or backward castes. However, this may reflect larger patterns of GVK EMRI 108 service utilization. Individuals from higher socioeconomic groups may have greater access to other modes of transportation and do not need to utilize this free service. This study reveals that people from lower socioeconomic strata use a free EMS system more often than those from upper economic strata. There was also preliminary evidence that the burden of CVD in rural areas is increasing.^[26]

Twenty-three percent of cases the response time were found to be within 8 min, a referenced standard for EMS.^[27] Vukmir in his study found that response time affects the survival rate in cardiac emergencies.^[28] The mean response time varied in different states and likely due to different landscape and terrains across different operating states. Although the response times were comparable with the rest of the world, we believe that such times need to improve to provide the best quality care.

Further research is necessary to evaluate similar EMS data and identify ways to capture their full utility.

CONCLUSIONS

In cardiac emergencies, ambulance based emergency medical services are the important link in the chain of survival. In view of the time sensitive interventions required in cardiac emergencies and anticipated growing burden of CVDs, such EMS services should be available throughout the country including rural areas on high priority.

Close monitoring of the response time of EMS is critical. Plans should be in place to further reduce the

current response times. Training of Emergency Response Officers and involvement of Emergency Response Center Physicians in cardiac emergencies may have higher survival rates and desired prognosis.

Bystander CPR, Public Access AED and Telephone CPR are strongly recommended in case of sudden cardiac arrest situations. EMT education and re-education should remain to be a continuous endeavor. Protocol adherence by pre hospital care providers and ERC Physicians in providing On Line Medical Direction can reduce deaths and enable appropriate management of cardiac emergencies. Pre arrival information including ECG transmission should be considered even in India at the earliest. Communities, EMS and hospital based care should have care continuum. Cardiac emergency education, training and research at basic and advanced levels of care should remain high in Non Communicable Diseases agenda at the national level.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res* 2007;125:217-30.
- Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: Analysis of worldwide data. *Lancet* 2005;365:217-23.
- Reddy KS, Naik N, Prabhakaran D. Hypertension in the developing world: A consequence of progress. *Curr Cardiol Rep* 2006;8:399-404.
- Gupta R, Mohan I, Narula J. Trends in coronary heart disease epidemiology in India. *Ann Glob Health* 2016;82:307-15.
- Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, *et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197-223.
- Kumar A, Cannon CP. Acute coronary syndromes: Diagnosis and management, part I. *Mayo Clin Proc* 2009;84:917-38.
- Wibring K, Herlitz J, Christensson L, Lingman M, Bång A. Prehospital factors associated with an acute life-threatening condition in non-traumatic chest pain patients – A systematic review. *Int J Cardiol* 2016;219:373-9.
- Kobusingye OC, Hyder AA, Bishai D, Joshipura M, Hicks ER, Mock C. Emergency Medical Services. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, *et al.*, editors. *Disease Control Priorities in Developing Countries*. 2nd ed., Ch. 68. Washington, DC: The International Bank for Reconstruction and Development/The World Bank; 2006. Co-published by Oxford University Press, New York. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK11744/>. [Last accessed on 2016 Jul 16].
- Sasser S, Varghese M, Kellermann A, Lormand J. *Prehospital Trauma Care Systems*. Geneva: WHO; 2005.
- Martinez R. New vision for the role of emergency medical services. *Ann Emerg Med* 1998;32:594-9.
- Roudsari BS, Nathens AB, Cameron P, Civil I, Gruen RL, Koepsell TD, *et al.* International comparison of prehospital trauma care systems. *Injury* 2007;38:993-1000.
- Prasanthi P. "Emergency Services in India-Counting on betterment," *Asian Hospital and Healthcare Management*. Available from: <http://www.asianhnm.com/healthcare-management/emergency-services-india>. [Last accessed on 2016 Jul 16].
- Saddichha S, Saxena MK, Pandey V, Methuku M. Emergency medical epidemiology in Assam, India. *J Emerg Trauma Shock* 2009;2:170-4.
- Sharma M, Ganguly NK. Premature coronary artery disease in Indians and its associated risk factors. *Vasc Health Risk Manag* 2005;1:217-25.
- Kannel WB, Gagnon DR, Cupples LA. Epidemiology of sudden coronary death: Population at risk. *Can J Cardiol* 1990;6:439-44.
- Jones DW, Chambless LE, Folsom AR, Heiss G, Hutchinson RG, Sharrett AR, *et al.* Risk factors for coronary heart disease in African Americans: The atherosclerosis risk in communities study, 1987-1997. *Arch Intern Med* 2002;162:2565-71.
- Lawlor DA, Ebrahim S, Davey Smith G. Sex matters: Secular and geographical trends in sex differences in coronary heart disease mortality. *BMJ* 2001;323:541-5.
- Jousilahti P, Vartiainen E, Tuomilehto J, Puska P. Sex, age, cardiovascular risk factors, and coronary heart disease: A prospective follow-up study of 14,786 middle-aged men and women in Finland. *Circulation* 1999;99:1165-72.
- Wingard DL, Suarez L, Barrett-Connor E. The sex differential in mortality from all causes and ischemic heart disease. *Am J Epidemiol* 1983;117:165-72.
- Hossain A, Khan HT. Risk factors of coronary heart disease. *Indian Heart J* 2007;59:147-51.
- Pearson TA, Jamison DT, Trejo-Gutierrez H. Cardiovascular disease. In: Jamison DT, editor. *Disease Control Priorities in Developing Countries*. New York: Oxford University Press; 1993. p. 577-99.
- Reddy KS, Prabhakaran D, Jeemon P, Thankappan KR, Joshi P, Chaturvedi V, *et al.* Educational status and cardiovascular risk profile in Indians. *Proc Natl Acad Sci U S A* 2007;104:16263-8.
- Pais P, Pogue J, Gerstein H, Zachariah E, Savitha D, Jayprakash S, *et al.* Risk factors for acute myocardial infarction in Indians: A case-control study. *Lancet* 1996;348:358-63.
- Gupta DK, Verma LK, Khosla PK, Dash SC. The prevalence of microalbuminuria in diabetes: A study from North India. *Diabetes Res Clin Pract* 1991;12:125-8.
- Rastogi T, Reddy KS, Vaz M, Spiegelman D, Prabhakaran D, Willett WC, *et al.* Diet and risk of ischemic heart disease in India. *Am J Clin Nutr* 2004;79:582-92.
- Joshi R, Cardona M, Iyengar S, Sukumar A, Raju CR, Raju KR, *et al.* Chronic diseases now a leading cause of death in rural India – Mortality data from the Andhra Pradesh Rural Health Initiative. *Int J Epidemiol* 2006;35:1522-9.
- Eisenberg MS, Bergner L, Hallstrom A. Cardiac resuscitation in the community. Importance of rapid provision and implications for program planning. *JAMA* 1979;241:1905-7.
- Vukmir RB. Survival from prehospital cardiac arrest is critically dependent upon response time. *Resuscitation* 2006;69:229-34.