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## **Title: Emerging burden of cardiovascular diseases in Bangladesh**

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**Abstract:**

As a result of an epidemiological transition from communicable to non-communicable diseases for last few decades, cardiovascular diseases (CVD) are being considered an important cause of mortality and morbidity in many developing countries including Bangladesh. Performing an extensive literature search, we compiled, summarized, and categorized the existing information regarding CVD mortality and morbidity among different clusters of Bangladeshi population. The present review reports that the burden of CVD in terms of mortality and morbidity is on the rise in Bangladesh. Despite a few non-communicable disease prevention and control programs currently running in Bangladesh, there is an urgent need for well-coordinated national intervention strategies and public health actions to minimize the CVD burden in Bangladesh. While the main challenge for CVD control in a developing country is unavailability of adequate epidemiological data related to various CVD events, the present review attempted to accumulate such data in the current context of Bangladesh. This might be of interest to all stakeholder groups working for CVD prevention and control across the country and the globe.

**Key words:** Bangladesh, Cardiovascular Diseases, Heart, Stroke, Burden, Population.

## **Introduction:**

Cardiovascular diseases (CVD) are being considered an important cause of mortality and morbidity in many developing countries including Bangladesh[[1-6](#)]. Bangladesh has been witnessing an ‘epidemiological transition’[[7](#)] from communicable to non-communicable diseases for last few decades[[2, 8, 9](#)]. During the period 1986–2006, estimated chronic disease-related mortality raised from 8% to 68%, while estimated communicable disease mortality dropped from 52% to 11% in a part of rural Bangladesh[[8](#)]. This epidemiological transition toward a higher chronic disease burden particularly by CVD is occurring most likely as a consequence of rapid urbanization[[2, 4, 10-12](#)], change in dietary habits and lifestyle[[2, 4, 11, 13, 14](#)], popularity of fast food items and beverages[[4, 15](#)], rising consumption of tobacco[[4, 11, 16](#)], increase in buying capacity[[1, 15](#)], decrease in levels of physical activity[[2, 4, 14, 16-18](#)], successful immunization programs against childhood infectious disease[[9](#)], and concomitant decline of infectious and nutritional disorders[[11, 12](#)] in the country.

Because the traditional health care system is designed mainly to address acute communicable diseases, the increasing prevalence of chronic disease is a major challenge in most of the developing countries[[19](#)]. Besides this, lack of well-organized morbidity and mortality data is an obstacle to preventing and controlling chronic diseases. Prior to undertaking any appropriate measures to address the rising CVD problems, it is imperative to assess the disease burden in terms of mortality and morbidity, and simultaneously to characterize the population who are at higher risk.

This review article compiled, summarized, and categorized the existing information regarding CVD mortality and morbidity among different clusters of Bangladeshi population.

Moreover, this paper determined the extent of Bangladesh-relevant CVD studies that have been already conducted, and explained the importance of CVD prevention interventions in the current context of Bangladesh.

In this paper, we have used the term ‘cardiovascular diseases (CVD)’ according to the definitions of Global Burden of Disease (GBD) cause categories in terms of International Classification of Diseases, Tenth Revision (ICD-10) codes[20]. Here, CVD includes 1) Rheumatic heart disease [ICD-10 code: I01-I09], 2) Hypertensive heart disease [ICD-10 code: I11p, I13], 3) Ischemic heart disease [ICD-10 code: I20-I25], 4) Cerebrovascular disease [ICD-10 code: I60-I69], 5) Inflammatory heart diseases [ICD-10 code: I30-I33, I38, I40, I42], and 6) Other cardiovascular diseases [ICD-10 code: I00, I26-I28, I34-I37, I44-I51, I70-I99][20].

### **Methods:**

We performed an extensive literature search from a wide range of literature sources. The flow diagram of literature search and selection methods is shown in Figure 1. To find out relevant studies, we searched PubMed and Scholar Google using search terms "cardiovascular diseases", "coronary artery disease", "ischemic heart disease", "myocardial infarction", "cerebrovascular diseases", or "stroke" in combination with a common keyword "Bangladesh" during each search (for example, "cardiovascular diseases and Bangladesh"). We screened papers that were published between 1971 and 2014. Reference lists from the selected papers were also searched manually to identify potentially relevant articles. In addition, we searched Bangladeshi local journals (those not indexed in PubMed), WHO databases, websites, book chapters, and reports.

## **Mortality and morbidity caused by CVD in Bangladesh**

Data from the World Health Organization (WHO) regarding age-standardized death rates for CVD in South Asian countries in 2008 are shown in Figure 2. Overall CVD mortality in Bangladesh was higher than the death rates in Sri Lanka, Nepal, Myanmar, Maldives, and India. **The differences in age-adjusted cardiovascular mortality across the countries might be explained, to some extent, by some important factors like variability in availability and accessibility of intensive care units, invasive coronary care and thrombolytic therapy in the hospitals. More over, over the past decades these factors have contributed to the difference in CVD death rates between the developing and developed part of the globe.** Figure 2 also illustrates that age-standardized CVD death rate in Bangladesh was higher among males compared to females. The government 'Health Bulletin 2013' reported that diseases of the circulatory system, which includes CVD, were the top most causes of deaths (12,149 deaths; 12.2%) across 504 public hospitals in Bangladesh in 2012[4].

During the period 2008–2012, the number of outdoor visits and admissions in the National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh showed a rising trend[4]. Total number of outdoor visits was elevated from 147,570 to 174,366, while total number of admissions increased from 33,946 to 44,559 over that 5 years period. In 2005, a study was carried out in several Southeast Asian countries including Bangladesh to find out the self-reported prevalence of chronic diseases among general population[21]. In this study, Van Minh et al. reported that the prevalence of 'self-reported heart disease' among 25-64 years aged Bangladeshi male population in 3 different locations/settings ranged from 5.3% to 66.3%, whereas the prevalence among the female population was 7.8% to 77.7%[21]. However, prevalence of various CVD among Bangladeshi general population is summarized from a range of selected studies in Table 1.

## **Ischemic heart disease**

According to the WHO data, overall age-standardized death rate for ischemic heart disease (IHD) in Bangladesh was 203.7 per 100,000 in 2008, which was higher in comparison with the IHD death rates in Sri Lanka, Nepal, Myanmar, Maldives, and India [Figure 3]. In Bangladesh, mortality due to IHD was relatively lower among females than males. However, IHD was the most common cause of death among the estimated total deaths due to different types of CVD [Figure 4]. Acute myocardial infarction (AMI) appeared as the top leading cause (3.7%) of deaths across 504 public hospitals in Bangladesh in 2012, as reported by the 'Health Bulletin 2013' [4].

According to the morbidity profile of the patients admitted to 5 medical college hospitals in Bangladesh, myocardial infarction was in the 3<sup>rd</sup> position (2.82%) as a cause of hospitalization in 2012, while acute myocardial infarction was the top leading cause (27.75%) of admissions in NICVD, Dhaka, Bangladesh during the same year [4]. Similarly, AMI was found to be the most common (28.4%) reason of hospitalizations in the cardiology department of Sher-E-Bangla Medical College, Barisal, Bangladesh over a period from May 2010 to April 2012 [22]. A global case-control study of risk factors for early acute myocardial infarction reported that the mean age (51.9 years) of occurring acute myocardial infarction among Bangladeshi population was the lowest amongst all South Asians, and it was 6 years lower compared to the non-South Asians (58.8 years) [17].

A number of studies [23-27] reported the prevalence of IHD within different contexts and cohorts consisted of either general population [Table 1] or hospital-based patients [Table 2] in Bangladesh. The IHD prevalence was found as high as 18.9% among 106 hospitalized stroke patients [26], while a lower prevalence (2.7%) was reported in a cluster (n=226) of

rural elderly population[25]. In 2001, Zaman et al. investigated for the IHD burden among 447 adults in a rural community of Bangladesh[23]. In this study, the investigators reported that the overall prevalence of IHD was 3.4%, while the prevalence in 157 men (4.6%) was nearly twice than in 290 women (2.7%)[23]. Another study conducted by Ahsan et al. revealed that the prevalence of IHD was 17.2% among 163 adult subjects in an urban setting of Dhaka city[24].

### **Rheumatic fever and rheumatic heart disease**

Rheumatic fever and rheumatic heart disease are prevalent among the child population in Bangladesh[28-31]. Among the estimated deaths due to different types of CVD, rheumatic heart disease contributes 3% of total male deaths and 4% of total female deaths in 2008 [Figure 4]. The 'Health Bulletin 2013' reported that there were a total of 27,479 outdoor visits by the patients (38.6% males and 61.4% females) suffering from rheumatic heart diseases and related conditions to the National Center for Control of Rheumatic Fever and Heart Diseases, Dhaka, Bangladesh in 2012[4]. Average daily number of outdoor visits to this hospital was 75.3. Ahmed et al. carried out a community-based study among 5923 rural Bangladeshi children aged 5-15 years, where the prevalence of rheumatic fever and rheumatic heart disease were found to be 1.2 per 1000 and 1.3 per 1000, respectively[28]. In another study, Zaman et al. reported a higher prevalence (15.7%) of rheumatic fever among 337 outpatient department (OPD) attendees aged 5-20 years in the National Center for Control of Rheumatic Fever and Heart Diseases, Dhaka, Bangladesh[29]. In 2005, a national level cross-sectional survey was conducted to determine the prevalence of rheumatic fever and rheumatic heart disease among Bangladeshi children[31]. This survey revealed that the prevalence of rheumatic fever was 0.6 per 1000 (CI: 0.4–0.9) and the prevalence of rheumatic heart disease was 0.3 per 1000 (CI: 0.2–0.5)[31]. However, in another contemporary study,



Majumder et al. reported a comparatively higher prevalence of rheumatic fever (4.22 per 1000) among the children of a rural school in Bangladesh[30].

### **Cerebrovascular disease**

Figure 5 shows age-standardized death rates for cerebrovascular disease (CeVD) in South Asian countries in 2008. Bangladesh had an overall CeVD mortality of 108.3 per 100,000, which was comparatively higher than the death rates in Sri Lanka, Nepal, Myanmar, and Maldives. Age-standardized death rate due to CeVD was found higher among males compared to females in Bangladesh, as shown in Figure 5. Moreover, CeVD contributes around one-fourth of the estimated total deaths caused by different types of CVD in Bangladesh [Figure 4]. Of 4870 total deaths occurred in a rural area of Bangladesh during 2005-2008, 1250 deaths were caused by stroke indicating a population-attributable mortality of 25% for stroke[32]. In the 'Health Bulletin 2013', stroke (not specified as hemorrhage or infarction) was reported as top 6<sup>th</sup> cause (1.1%) of deaths across 504 public hospitals in Bangladesh in 2012[4]. Mohammad et al. conducted a community based door-to-door survey in order to find out the prevalence of stroke in a Bangladeshi population aged 40 years and above[33]. In this study, among 15,627 study participants, a total of 47 participants found to have stroke, indicating an overall prevalence of 3.00 per 1000 (95% CI: 0.95–2.45), and the prevalence was comparatively higher among males and rural people[33]. In another study Van Minh et al. revealed that the prevalence of 'self-reported stroke' in 3 different sites of Bangladesh ranged from 0.5% to 2.0% among males, and from 0.7% to 1.8% among females in 2005[21]. Furthermore, Zaman et al. reported a stroke prevalence of 9.4 per 1000 (95% CI: 4.8–13.9) in a rural population of Bangladesh, where the prevalence was 3.2 times higher in men than in women[34].

### **Socioeconomic consequences of CVD burden in Bangladesh**

From the studies and reports discussed above, it is evident that the burden of CVD in terms of mortality and morbidity is on the rise in Bangladesh. The health and socioeconomic consequences of CVD burden might be complicated by the fact that a considerable proportion (43.3%) of Bangladeshi people are living in poverty[35]. The government health care facilities may not be able to provide appropriate best possible management to the huge number of CVD patients from lower socioeconomic class. On the contrary, expensive interventions and costly drugs will be accessible and affordable only to the elite minority through few private hospitals. Given that, like other developing countries Bangladesh is already facing the double burden of communicable and non-communicable diseases[36], paying adequate attention to both categories of diseases may not be possible by the existing low resource health care system.

### **Ongoing CVD prevention and control programs in Bangladesh**

Prevention and control of non-communicable diseases (NCDs) has been given one of the top most priorities in the current Health, Population and Nutrition Sector Development Program (HPNSDP) 2011-2016 in Bangladesh[4]. Bleich et al. identified a total of 11 governmental and non-governmental chronic diseases programs currently running in Bangladesh[37]. Of these NCD programs, following 5 programs/institutes already established CVD prevention and control activities as one of their major objectives: 1) Non-communicable Disease Control and Public Health Intervention Program of the Directorate General for Health Services, 2) National Institute of Cardiovascular Disease (NICVD), 3) National Heart Foundation (NHF), 4) Health Care Development Project (HCDP); part of the Diabetes Association of Bangladesh (DAB), 5) Upazilla NCD Project[37]. A non-governmental organization (NGO) named Centre for the Rehabilitation of the Paralysed

(CRP-Bangladesh) is currently providing stroke rehabilitation services and long-term stroke care to the patients with stroke[38]. However, establishment of efficient systems for estimation of CVD-related burden is one of the essential components of any CVD control program[11], that is still lacking in Bangladesh.

### **Need for well-coordinated intervention strategies and efforts**

There is an urgent need for well-coordinated national intervention strategies and public health actions to minimize the CVD burden in terms of mortality and morbidity in Bangladesh. Because the existing health care infrastructure in Bangladesh is equipped to handle mostly the infectious and nutritional deficiency disorders, it must be rearranged to combat the challenge of growing CVD burden. Collaborative involvement and participation of all stakeholders including governmental and non-governmental agencies, physicians, researchers, professional organizations, patient support groups and mass media is urgently required in order to design and implement the CVD prevention and control measures across the country.

Implementation of the specific policy recommendations that were formulated on the basis of findings of the ‘Non-Communicable Disease Risk Factor Survey Bangladesh 2010’[16] might be a good initiative to address the CVD burden issue. The ‘Committee on Preventing the Global Epidemic of Cardiovascular Disease’ has documented a series of recommendations to combat the growing epidemic of CVD in the developing world[2]. These recommendations might be of useful to local policy makers and health leaders in Bangladesh. Local professional societies may come forward to organize CVD education and public awareness programs for grass-roots level population. An effective campaign for primary

prevention of CVD requires adequate funding that should be ensured by governmental organizations and non-governmental donor agencies.

Despite advances in the knowledge and understanding of CVD around the world, including a number of Asian countries like Japan[39, 40], Korea[14, 41] and Singapore[12], there is limited academic infrastructure for carrying out CVD-related studies in Bangladesh. Innovative policy-relevant researches targeting to explore cost-effective intervention strategies for combating the CVD burden should be a specific area of focus. Furthermore, our literature search showed that longitudinal cohort studies of CVD in the context of Bangladesh are significantly lacking. Such studies are essential to find out the local incidence of CVD, and to understand the disease progression and prognosis. However, conducting long-term cohort studies in Bangladesh is always a big challenge for the local researchers. The main challenge for CVD control in a developing country like Bangladesh is unavailability of adequate epidemiological data related to fatal and non-fatal CVD events. The present review attempted to accumulate such data in the current context of Bangladesh, which might be of interest to all stakeholder groups working for CVD prevention and control across the country. Although our article focuses the emerging CVD burden in Bangladesh, it reflects the similar situation prevailing in many developing countries. Therefore, our recommendations and call for public health actions in the field of cardiovascular prevention are concurrently applicable to other developing countries throughout the world.

**Conflict of Interest:**

The authors declare no conflict of interest.

**Table 1: Prevalence of cardiovascular diseases among general population in Bangladesh from a range of selected studies**

Disease	Diagnostic criteria	Author	Study Period	Study setting	Age range in years	Sample size	Prevalence
Ischemic heart disease	Presence of pathological Q wave on electrocardiogram, or on medication for IHD	Zaman et al.[23]	2001	Rural	≥ 20	Male: 157 Female: 290	Male: 4.6% Female: 2.7%
	Identified by using standardized WHO questionnaires	WHO [42]	2004	Urban and rural	≥ 30	Male: 2276 Female: 2118	Male: 26 per 1000 Female: 25 per 1000
	Based on electrocardiogram	Ahsan et al.[24]	2007	Urban	Mean age: 44.8 ± 8.3	163	17.2%
	Diagnostic criteria not mentioned	Ahmed et al.[25]	2007	Rural	≥ 50	226	2.7%
Heart disease	Self-reported by the respondents	Van Minh et al.[21]	2005	DSS site: HSID	25 – 64	Male: 2016 Female: 2007	Male: 6.4% Female: 7.8%
				DSS site: WATCH	25 – 64	Male: 1000 Female: 1000	Male: 66.3% Female: 77.7%
				DSS site: Matlab	25 – 64	Male: 1047 Female: 1026	Male: 5.3% Female: 10.7%
Left ventricular hypertrophy	Diagnostic criteria not mentioned	Ahmed et al.[25]	2007	Rural	≥ 50	226	2.2%
Rheumatic fever	Clinical diagnosis	Banoo et al.[43]	1987	Urban school	4 – 17	4349	43.9 per 1000
		Mahmud et al.[44]	1989	Urban school	5 – 18	5011	0.9 per 1000
		Begum et al.[45]	1990	Urban school	5 – 15	10,538	2.4 per 1000
	Revised Jones Criteria	Ahmed et al.[28]	1991	Rural	5 – 15	5923	1.2 per 1000
	Updated Jones Criteria 1992	Zaman et al.[31]	2005	Urban and rural	5 – 19	Male: 28,999 Female: 27,828	Male: 0.6 per 1000 Female: 0.6 per 1000
		Majumder et al.[30]	2005	Rural school	4 – 18	947	4.22 per 1000
Rheumatic heart disease	Doppler echocardiography confirmed	Banoo et al.[43]	1987	Urban school	4 – 17	4349	5.1 per 1000
		Mahmud et al.[44]	1989	Urban school	5 – 18	5011	2.8 per 1000
		Ahmed et al.[28]	1991	Rural	5 – 15	5923	1.3 per 1000
		Zaman et al.[31]	2005	Urban and rural	5 – 19	Male: 28,999 Female: 27,828	Male: 0.3 per 1000 Female: 0.3 per 1000
	Clinical diagnosis; echocardiography not used	Begum et al.[45]	1990	Urban school	5 – 15	10,538	0.2 per 1000
		Majumder et al.[30]	2005	Rural school	4 – 18	947	0
Stroke	WHO screening protocol for neurological diseases and finally clinical evaluation by a neurological team	Mohammad et al.[33]	NA	Door-to-door survey	≥ 40	15,627	3.0 per 1000
	Identified by using standardized WHO	WHO [42]	2004	Urban and rural	≥ 30	Male: 2276	Male: 17 per 1000

questionnaires					Female: 2118	Female: 22 per 1000
Self-reported by the respondents	Van Minh et al. <a href="#">[21]</a>	2005	DSS site: HSID	25 – 64	Male: 2016 Female: 2007	Male: 2.0% Female: 1.5%
			DSS site: WATCH	25 – 64	Male: 1000 Female: 1000	Male: 0.5% Female: 0.7%
			DSS site: Matlab	25 – 64	Male: 1047 Female: 1026	Male: 1.6% Female: 1.8%
Screening by WHO stroke surveillance instrument, then diagnoses were confirmed by physicians	Zaman et al. <a href="#">[34]</a>	2007	Rural	≥ 30	Male: 827 Female: 882	Male: 14.5 per 1000 Female: 4.5 per 1000

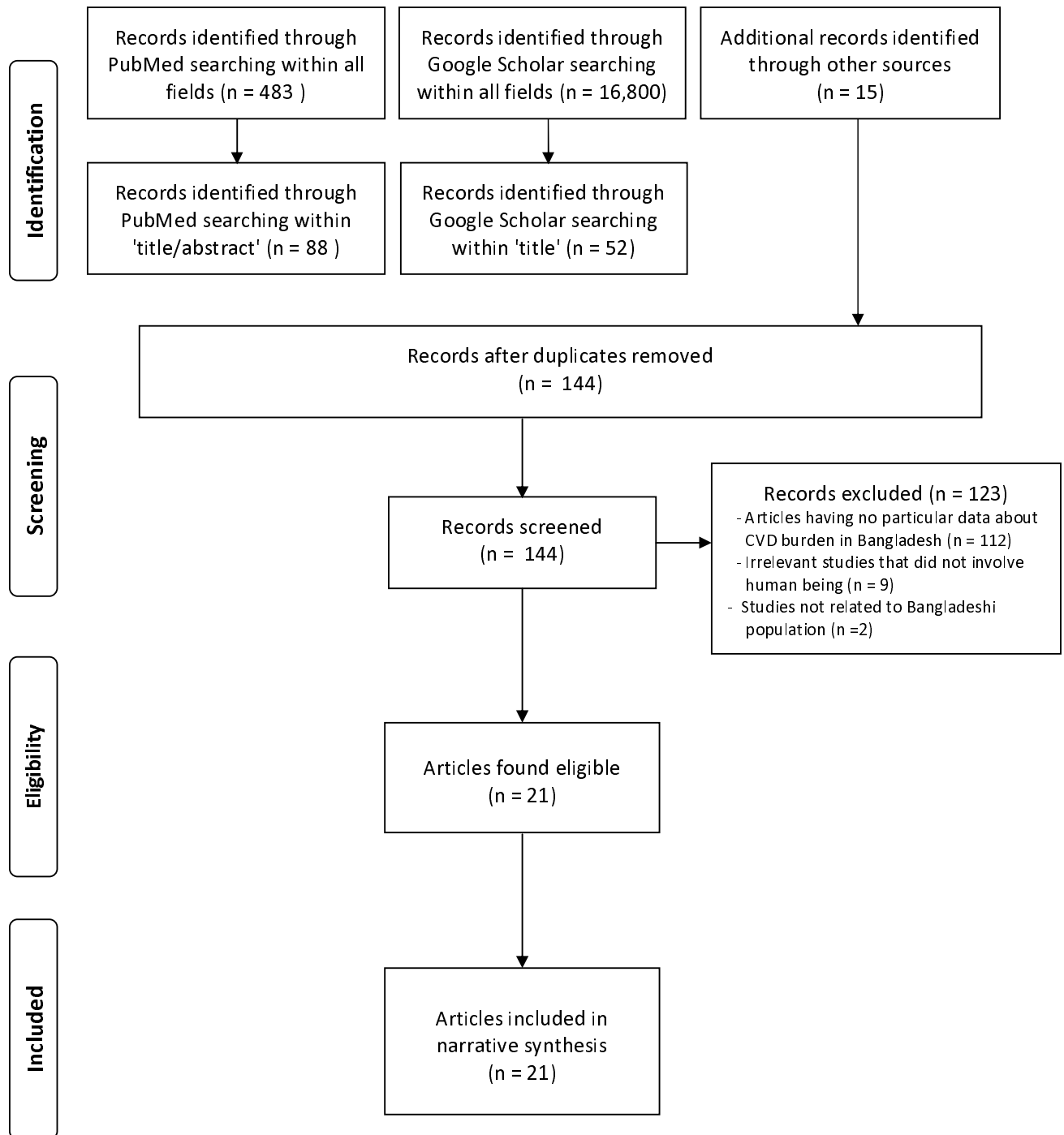
NA = Not available; DSS: demographic surveillance system; HSID = Health System and Infectious Disease; WATCH = Woman Abuse Tracking in Clinics and Hospitals.

**Table 2: Cardiovascular diseases among hospital-based patients in Bangladesh from a range of selected studies**

Disease	Diagnostic criteria	Author	Study Period	Study setting	Age range in years	Sample size	Percentage
Ischemic heart disease	Based on electrocardiogram	Mollah et al. [26]	NA	Hospitalized stroke patients	Mean age : 60 ± 13.7	106	18.9%
	Diagnoses done by hospital physicians	WHO [42]	2004	Patients attended emergency, OPD, and IPD in four medical college hospitals	≥ 30	Male: 2360 Female: 1423	Male: 5.1% Female: 2.3%
	Previously known cases, or newly diagnosed cases in the hospital	Saha et al. [27]	2008 – 2009	Hospital-based CKD-V patients	> 18	300	18.3%
Heart failure	Patients with persistent or recurrent dyspnea plus two of the followings: Raised jugular venous pressure, bibasilar crackles, pulmonary venous hypertension or interstitial edema on chest X-ray	Saha et al. [27]	2008 – 2009	Hospital-based CKD-V patients	> 18	300	38%
Arrhythmia	Individuals having atrial or ventricular rhythm disorder requiring therapy	Saha et al. [27]	2008 – 2009	Hospital-based CKD-V patients	> 18	300	4.7%
Left ventricular hypertrophy	Individuals required to meet voltage criteria and had either the S-T segment characteristics or T wave characteristics	Saha et al. [27]	2008 – 2009	Hospital-based CKD-V patients	> 18	300	9%
Rheumatic fever	Revised Jones Criteria	Zaman et al. [29]	1994 – 1995	Hospital OPD attendees	5 – 20	337	15.7%
Stroke	Diagnoses done by hospital physicians	WHO [42]	2004	Patients attended emergency, OPD, and IPD in four medical college hospitals	≥ 30	Male: 2360 Female: 1423	Male: 5.6% Female: 3.8%

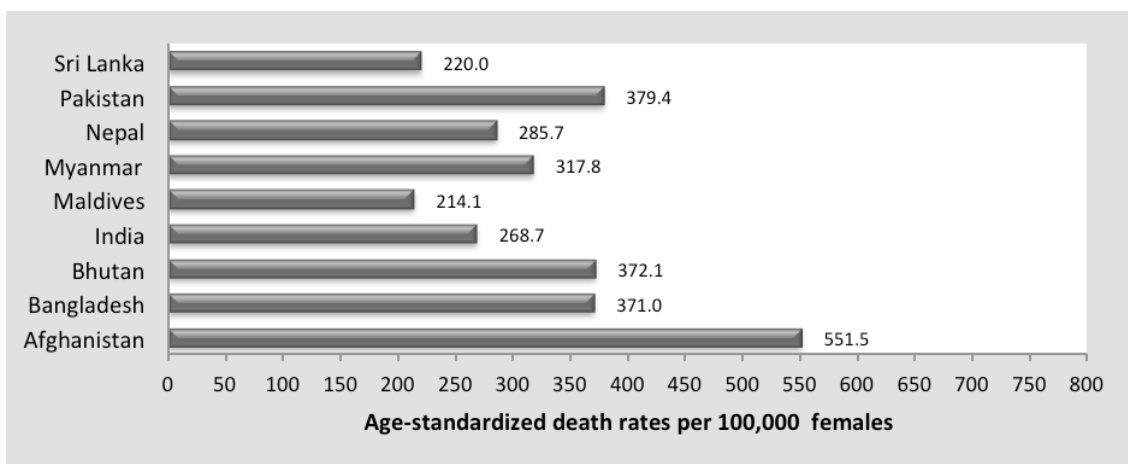
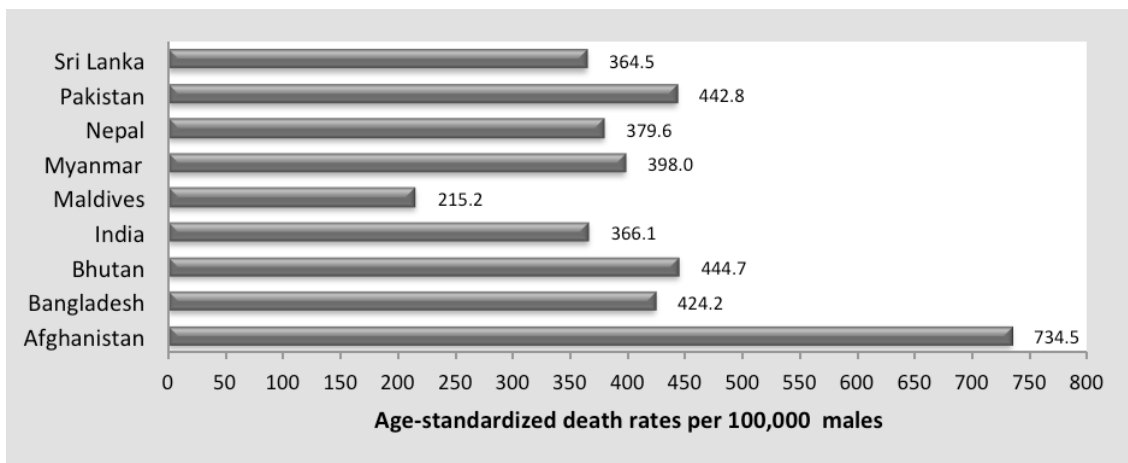
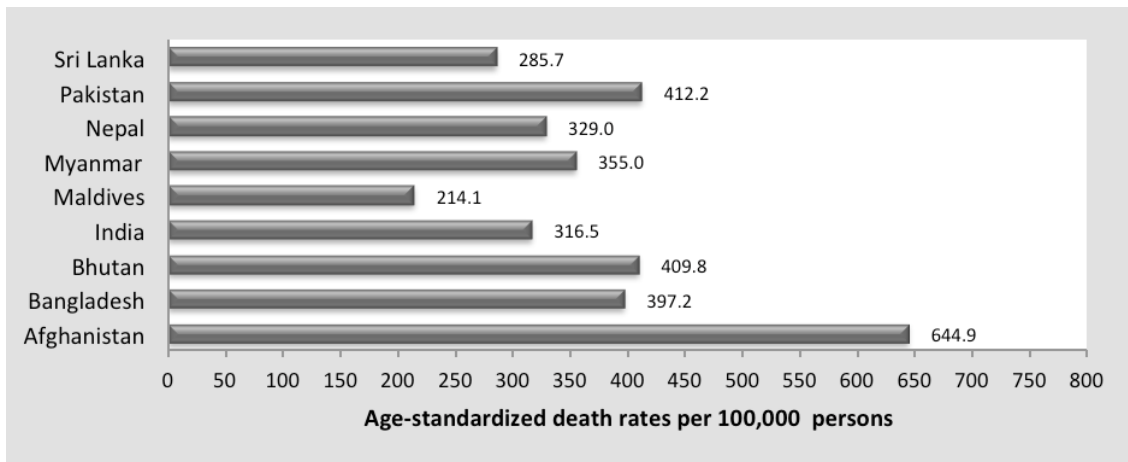
NA = Not available; CKD-V = Chronic Kidney Disease stage-V; OPD = Outpatient department, IPD = Inpatient department.

**Figure 1: Flow Diagram of literature search and selection**





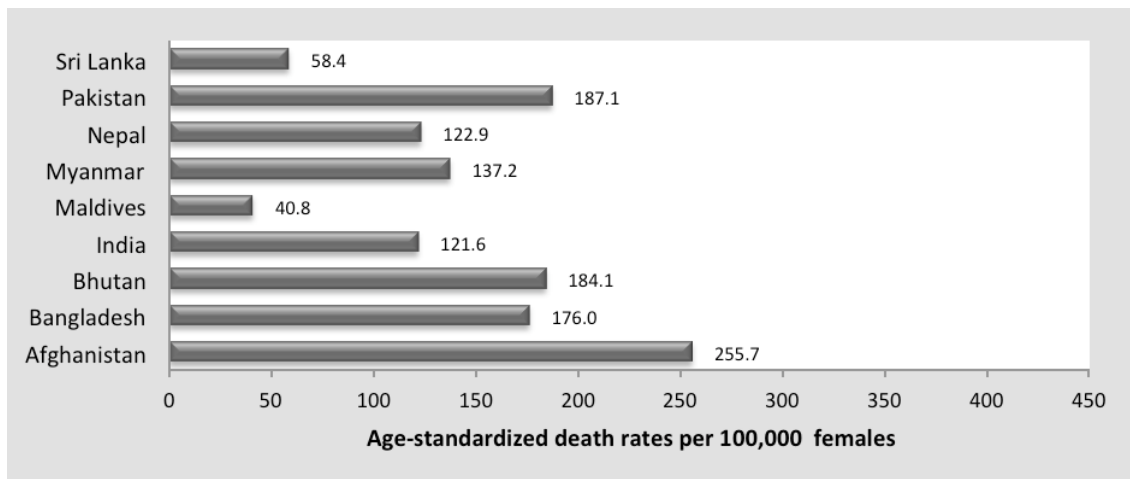
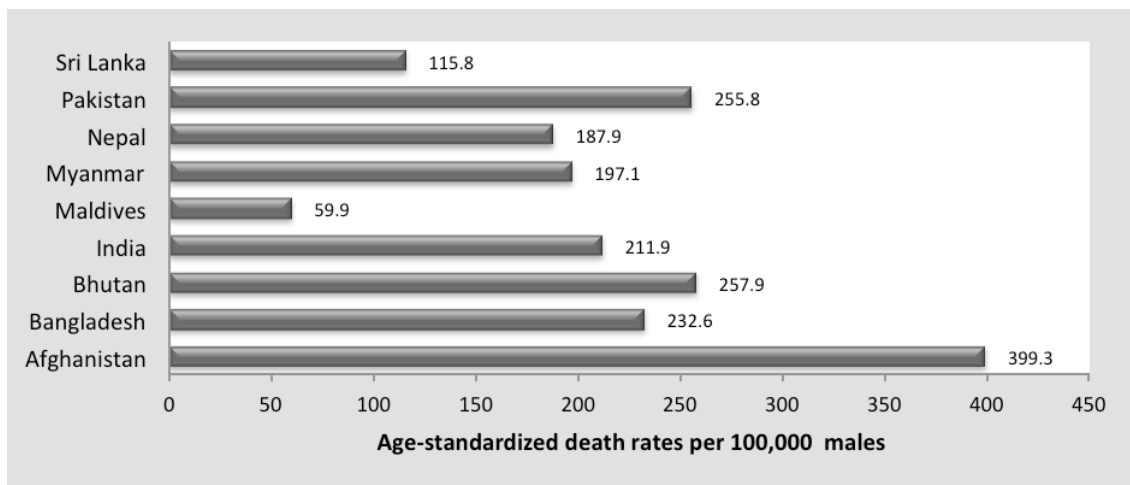
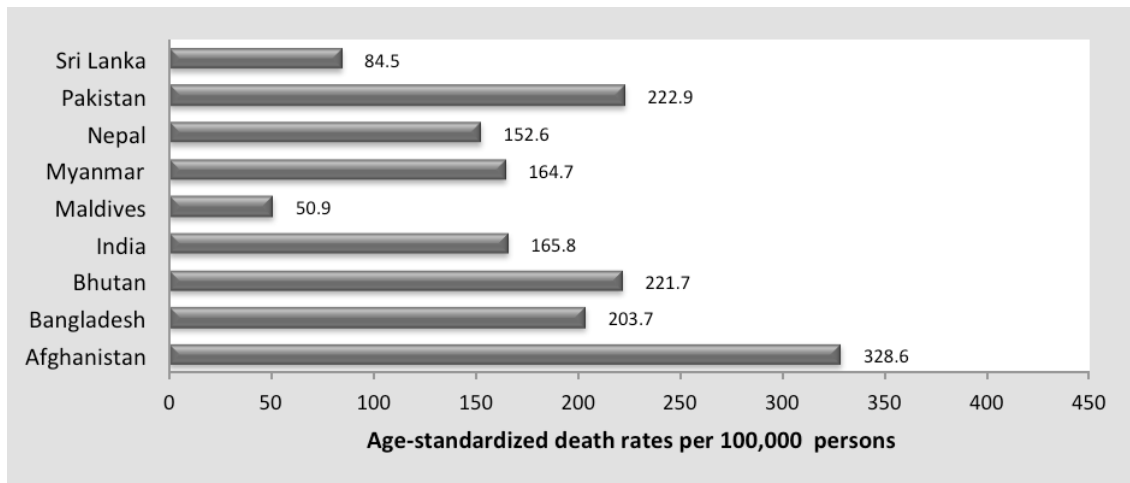
**Figure 2: Age-standardized death rates per 100,000 for \*cardiovascular diseases in South Asian countries by persons, males, and females, 2008.**



Data source: World Health Organization, Department of Measurement and Health Information. Age-standardized death rates per 100,000 by cause, sex and Member State, 2008. Geneva, World Health Organization, April 2011. Available at [http://www.who.int/gho/mortality\\_burden\\_disease/global\\_burden\\_disease\\_death\\_estimates\\_sex\\_2008.xls](http://www.who.int/gho/mortality_burden_disease/global_burden_disease_death_estimates_sex_2008.xls).

\*Cardiovascular diseases were coded according to the definitions of Global Burden of Disease (GBD) cause categories in terms of International Classification of Diseases, Tenth Revision (ICD-10) codes, and included 1) Rheumatic heart disease [ICD-10 code: I01-I09], 2) Hypertensive heart disease [ICD-10 code: I10-I13], 3) Ischaemic heart disease [ICD-10 code: I20-I25], 4) Cerebrovascular disease [ICD-10 code: I60-I69], 5) Inflammatory heart diseases [ICD-10 code: I30-I33, I38, I40, I42], and 6) Other cardiovascular diseases [ICD-10 code: I00, I26-I28, I34-I37, I44-I51, I70-I99][20, 46].

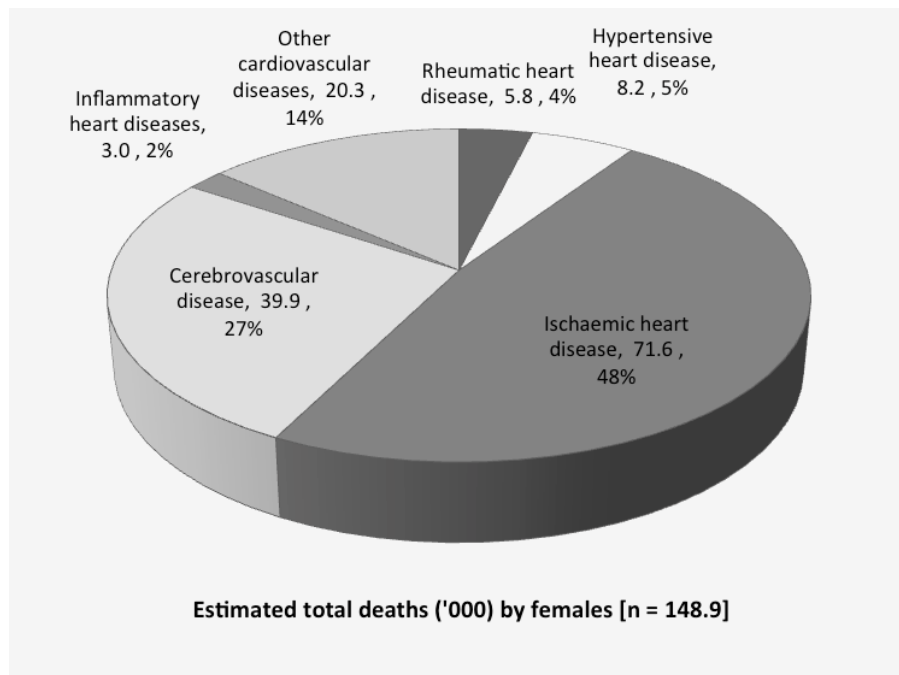
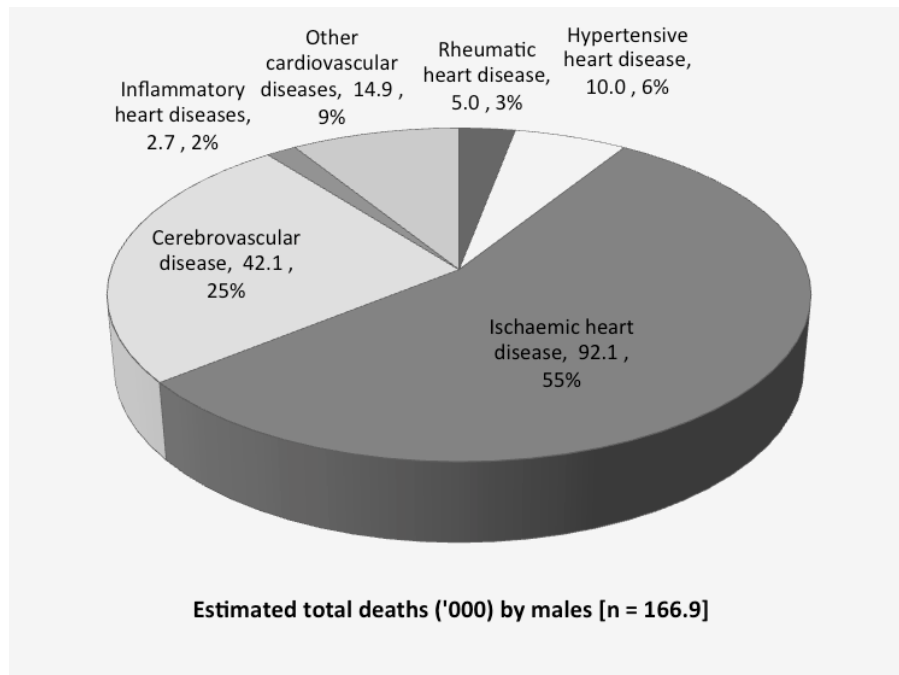
**Figure 3: Age-standardized death rates per 100,000 for \*ischemic heart disease in South Asian countries by persons, males, and females, 2008.**



Data source: World Health Organization, Department of Measurement and Health Information. Age-standardized death rates per 100,000 by cause, sex and Member State, 2008. Geneva, World Health Organization, April 2011. Available at [http://www.who.int/gho/mortality\\_burden\\_disease/global\\_burden\\_disease\\_death\\_estimates\\_sex\\_2008.xls](http://www.who.int/gho/mortality_burden_disease/global_burden_disease_death_estimates_sex_2008.xls).

\*Ischemic heart disease was coded according to the definitions of Global Burden of Disease (GBD) cause categories in terms of International Classification of Diseases, Tenth Revision (ICD-10) codes, and included the diseases belonging to ICD-10 codes I20-I25[20, 46].

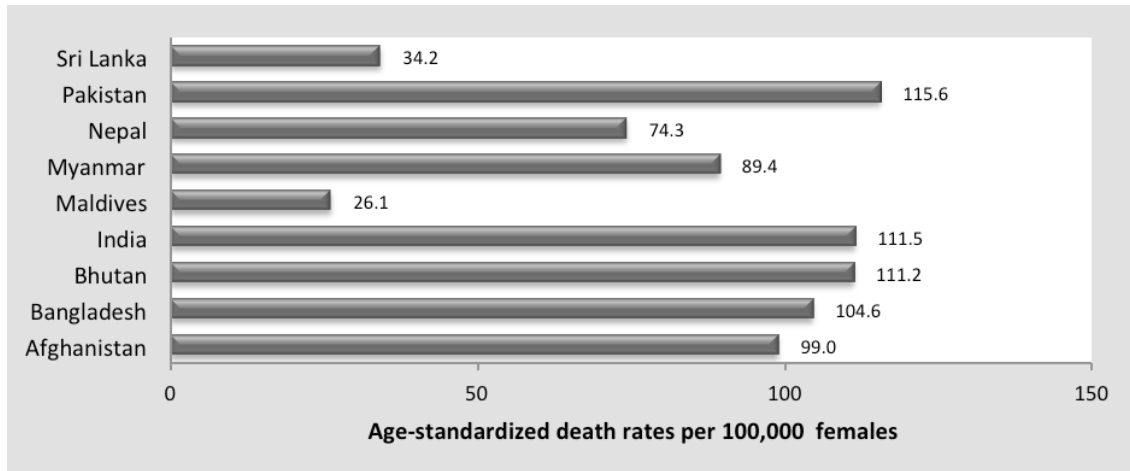
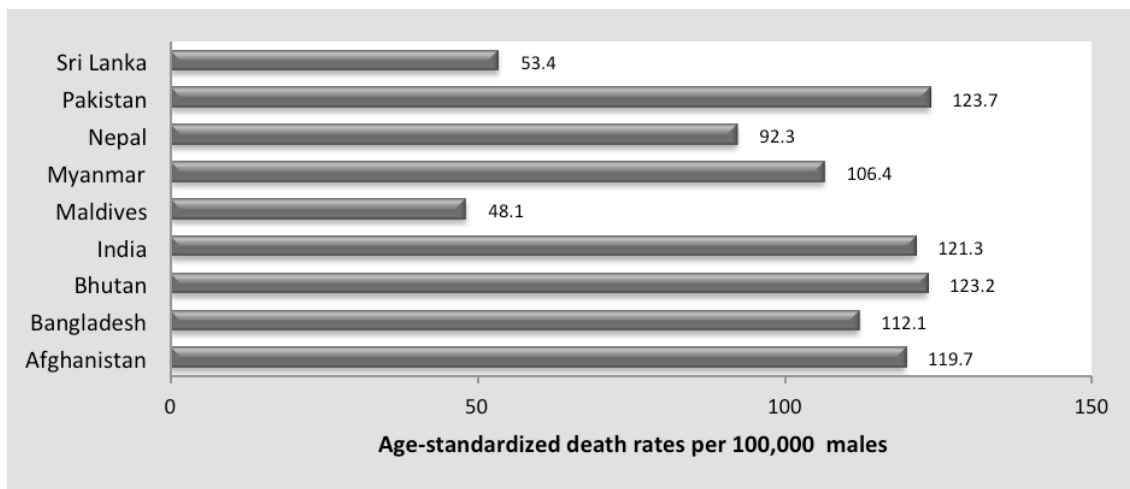
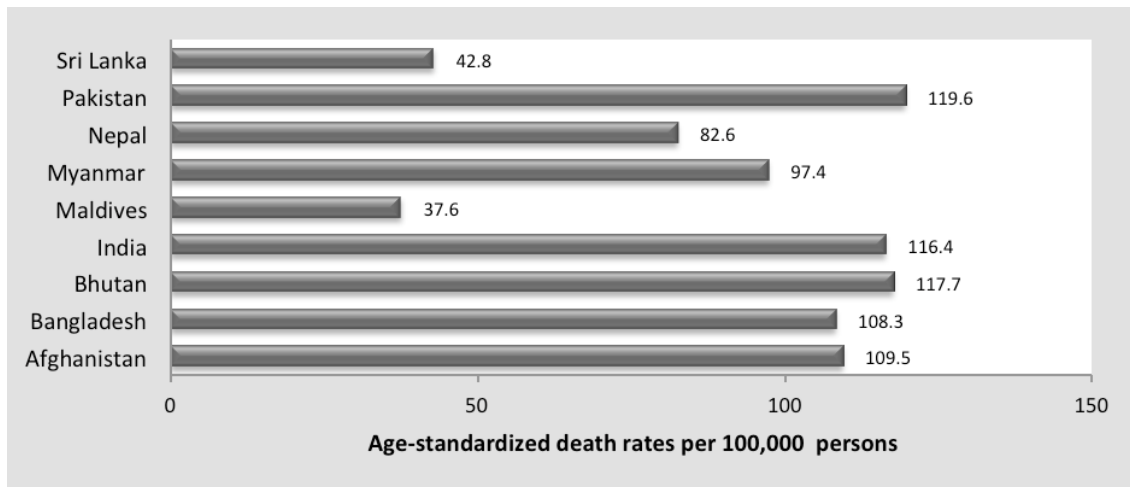
**Figure 4: Estimated total deaths ('000) for different type of \*cardiovascular diseases in Bangladesh by sex, 2008**



Data source: World Health Organization, Department of Measurement and Health Information. Estimated total deaths ('000), by cause, sex and WHO Member State, 2008. Geneva, World Health Organization, April 2011. Available at [http://www.who.int/gho/mortality\\_burden\\_disease/global\\_burden\\_disease\\_death\\_estimates\\_sex\\_2008.xls](http://www.who.int/gho/mortality_burden_disease/global_burden_disease_death_estimates_sex_2008.xls).

\*Cardiovascular diseases were coded according to International Classification of Diseases, Tenth Revision [ICD-10], and included 1) Rheumatic heart disease [ICD-10 code: I01-I09], 2) Hypertensive heart disease [ICD-10 code: I10-I13], 3) Ischaemic heart disease [ICD-10 code: I20-I25], 4) Cerebrovascular disease [ICD-10 code: I60-I69], 5) Inflammatory heart diseases [ICD-10 code: I30-I33, I38, I40, I42], and 6) Other cardiovascular diseases [ICD-10 code: I00, I26-I28, I34-I37, I44-I51, I70-I99][20, 46].

**Figure 5: Age-standardized death rates per 100,000 for \*cerebrovascular disease in South Asian countries by persons, males, and females, 2008.**



Data source: World Health Organization, Department of Measurement and Health Information. Age-standardized death rates per 100,000 by cause, sex and Member State, 2008. Geneva, World Health Organization, April 2011. Available at [http://www.who.int/gho/mortality\\_burden\\_disease/global\\_burden\\_disease\\_death\\_estimates\\_sex\\_2008.xls](http://www.who.int/gho/mortality_burden_disease/global_burden_disease_death_estimates_sex_2008.xls).

\*Cerebrovascular disease was coded according to the definitions of Global Burden of Disease (GBD) cause categories in terms of International Classification of Diseases, Tenth Revision (ICD-10) codes, and included the diseases belonging to ICD-10 codes I60-I69[20, 46].

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