



Blood pressure control in diabetes—the Indian perspective

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Abstract

A tremendous increase in the coexistence of diabetes and hypertension has been observed recently in India. Apart from lifestyle and genetic factors, socioeconomic status, age, gender, occupation and lack of awareness are also contributing to the tremendous increases in the prevalence of both the diseases. Hypertension has been long recognised as one of the major risk factors for chronic disease burden, morbidity and mortality in India, attributable to 10.8% of all deaths in the country. Even though microvascular complications are frequently linked to hyperglycaemia, studies have also proven the critical involvement of hypertension in the development of these co-morbidities. The co-occurrence of hypertension in diabetic patients considerably escalates the risks of coronary heart disease, stroke, nephropathy and retinopathy. The annual expenditure for diabetes for the Indian population was estimated to be 1541.4 billion INR (\$31.9 billion) in 2010. The expense of diabetes care further escalates in the presence of complications or co-morbidities. Generally, a diabetic patient with hypertension spent an average of 1.4 times extra than a diabetic patient without hypertension. Even though diabetes and hypertension are considered as important risk factors for cardiovascular and chronic kidney diseases, the awareness about the prevention, treatment and control of these diseases remains alarmingly low in the developing countries like India. The healthcare system in India should focus on better hypertension screening and control, especially in diabetic patients, to minimise the burden of the dual epidemic.

Introduction

Diabetes is a chronic disease that requires lifelong continuous medical care consuming large amounts of healthcare resources. According to International Diabetes Foundation, 425 million people have diabetes in the world that includes 82 million from the South East Asia region, and this number will expect to go up to 151 million by 2045 [1]. India is one among the six countries in South East Asia region that has the highest prevalence of diabetes and out of the 829,491,000 adult populations in India; 72,946,400 (8.8%) was found to have diabetes [1].

WHO estimates hypertension as one of the critical reasons for global premature death [2, 3]. The prevalence of hypertension varies with the region and the economic status

of the countries. Over the past few decades, the prevalence rate of hypertension in adults has turned down in high-income countries. On the contrary, the prevalence rate has been steady or growing in low- and middle-income countries [3]. A region-specific (urban and rural parts of north, east, west and south India), systematic review and meta-analysis carried out on the prevalence, awareness and control of hypertension among Indian population revealed an overall 29.8% prevalence for hypertension in India with significant difference between rural (27.6%) and urban parts (33.8%) [4]. Regional estimates for the prevalence rate demonstrated 14.5% for rural north, 31.7% for the east, 18.1% for the west and 21.1% for south India [4].

A tremendous increase in the coexistence of diabetes and hypertension has been observed recently in India. The occurrence of hypertension was found to be 1.5–2.0 times higher in patients with diabetes than those without diabetes. Similarly, nearly one-third of patients with hypertension develop diabetes in later years [5, 6]. This coexistence leads to an augmented risk and accelerates vascular complications [7, 8]. Observations of the Screening India's Twin Epidemic study, intended to scrutinise the prevalence of diabetes and hypertension in seven of the ten most populous states in India, showed that out of 15,575 study patients, a total of

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3227 (20.6%) had both diabetes and hypertension, with the highest number reported in Maharashtra (28.8%, $n = 531$). Out of the 7212 patients with hypertension, diabetes coexisted in 44.7% [9]. Similarly, among the 5427 patients with diabetes, more than half (59.5%) of them were reported to have hypertension [9].

Even though diabetes and hypertension are considered as important risk factors for cardiovascular and chronic kidney diseases (CKDs), the awareness about the prevention, treatment and control of these diseases remains alarmingly low in the developing countries like India [10]. In consideration with the very less awareness rate, attempts to alert and educate the public about the prevalence, risk factors and associated complications of diabetes and hypertension in a diverse population like India is a prime necessity to minimise the burden of the dual epidemic. Gathering the reliable information about the prevalence as well as coexistence of hypertension and diabetes in different regions of the country is also highly crucial for the advancement of existing health policies for national prevention and control of these critical ailments.

Factors contributing to the prevalence rate

Genetic factors and lifestyle are the two renowned vital elements involved in the development of both diabetes mellitus and hypertension. Apart from this, socioeconomic status (SES), age, gender, occupation and lack of awareness are also contributing to the tremendous increases in the prevalence of both the diseases.

Socioeconomic status

A population-based cross-sectional study conducted by Indian Council of Medical Research (ICMR–INDIAB) that analysed the episode of diabetes and pre-diabetes in 15 Indian states reported that there is a vast variation in the incidence of diabetes among different states. The prevalence rate was depended on the per-capita gross domestic product (GDP) of each state and also on the SES of the individuals residing in [11]. Higher numbers of diabetes cases were observed in the states with a high per-capita GDP. The prevalence rate of diabetes was more in individuals of high SES in the rural areas of all the states. However, in the urban areas of the more economically developed states, a higher incidence was observed in low SES groups. For instance, in the affluent states like Chandigarh, Maharashtra and Tamil Nadu, populations with low SES showed a higher frequency of diabetes [11].

According to WHO non-communicable diseases country profiles 2018 [3], the episode of hypertension fluctuate across the WHO regions, with the highest prevalence rate in

the countries having the lowest income groups. In 2015, 28% of the population in low-income countries had high blood pressure; whereas the incidence rate was 18% in the high-income countries [3]. Reviews of the studies on hypertension epidemiology in India have revealed its high incidence in both the urban and rural areas [12], with relatively fewer episodes in rural population [13]. Reports from various parts of India indicated that 25% of urban and 10% of rural populations were affected by hypertension [13–16]. Even though the incidence of hypertension is comparatively lower in the rural community, there has been a steady increase in frequency over the period [17, 18].

Age and gender

A review of the recent global trends showed that one in four men and one in five women (i.e. 22% of the adult population) had elevated blood pressure in 2015 [19]. The number of adults with elevated blood pressure augmented from 594 million in 1975 to 1.13 billion in 2015, with the hike noticed predominantly in low- and middle-income countries [3, 19]. The increase in the number of adults with hypertension is a net effect of growing population and age [19]. Information from the worldwide data for the global burden of hypertension in 2005 indicated that 20.6% of men and 20.9% of women were suffering from hypertension in India [16, 20, 21]. By the end of 2025, the prevalence rate was anticipated to be 22.9% and 23.6% in Indian men and women, respectively [21]. A cross-sectional study to assess the age and sex-specific associations of anthropometric measures with blood pressure in India reported the higher prevalence of hypertension in men than women, except in the age group of 50–59 years, where it was analogous [22].

Public awareness

Many studies from India have reported that even in the areas where the prevalence rates of these critical ailments were high, the awareness and control measures were significantly low [4, 10, 14, 23]. According to the reports from a community-based intervention programme carried out in Kerala, a South Indian state, among the observed hypertensive patients, merely 24% were aware of the condition, and only 20% were undergoing treatment [14]. In another study by Anchala et al. about the prevalence of awareness, treatment and control of blood pressure, around 33% urban and 25% of rural Indians were found to have hypertension. Among these hypertensive individuals, only 25% rural and 42% urban Indians were aware of their hypertensive status, and 25% rural and 38% of urban Indians were being treated for hypertension [4]. As the substantial burden of diabetes and hypertension is alarmingly increasing in India, making the public aware about

the disease prevention, timely diagnosis and appropriate interventions are the keys towards the battle against this twin epidemic [10].

Complications

The care of diabetes and its complications presents an enormous challenge for most healthcare professionals in developing countries like India. Even though microvascular complications (retinopathy, nephropathy and neuropathy) are frequently linked to hyperglycaemia, studies have also proven the critical involvement of hypertension in the development of these co-morbidities [24]. Hypertension has been linked to ischaemic heart disease, peripheral vascular diseases, stroke, myocardial infarction and renal failure [25]. It has been long recognised as one of the major risk factors for chronic disease burden, morbidity and mortality in India, attributable to 10.8% of all deaths in the country [26]. A systematic analysis report by Global Burden of Disease Study 2010, which compared the proportion of deaths or disease burden and injury attributable to 67 risk factors and risk factor clusters in 21 regions worldwide, ranked high blood pressure as the third most important risk factor that contributes to the disease burden in South Asia [27]. Both hypertension and diabetes predispose to the development of cardiovascular disease (CVD) and renal disease [28, 29]. The co-occurrence of hypertension in diabetic patients considerably escalates the risks of coronary heart disease, stroke, nephropathy and retinopathy [30–33]. Hypertension induces atherosclerosis in diabetes patients making them more susceptible for both microvascular and macrovascular chronic complications [26].

Among many microvascular diabetic complications, hypertension plays a predominant role in the progression of diabetic nephropathy by glomerular hyperfiltration. Diabetes and hypertension are contemplated as the prominent sources of end-stage renal disease (ESRD). Studies from all over the world have established the involvement of uncontrolled blood sugar levels and increased blood pressure towards the advancement of CKDs. An observational study from South India to determine the risk factors for the development of proteinuria, over 12 years, in the normoalbuminuric type 2 diabetes patients, reported that type 2 diabetes patients with uncontrolled diabetes and increased blood pressure are at higher risk of developing nephropathy [34]. Among the patients with normal renal function at baseline, 44.1% developed proteinuria during the follow-up. Those who developed nephropathy in later years had significantly high levels of glucose, HbA1c, systolic blood pressure, triglycerides and urea at baseline compared with the others [34].

India bears an alarming situation with regards to CVD status. This rate is much more than the economically

developed countries as well as other Asian countries [35]. CVD constitutes to the greater extent of mortality in men and women, in urban and rural populations and in developed and developing states of the country [36]. In India, more than 10.5 million deaths occur annually, and it was reported that CVD led to 20.3% of these deaths in men and 16.9% of all the deaths in women [36]. According to RGI data, proportionate mortality from CVD increased to 23% of total and 32% of adult deaths in the period 2010–2013 [37]. The mortality rate reaches to 35% in more developed urban locations [38]. Hypertension is directly responsible for 57% of deaths due to stroke and 24% owing to all coronary heart disease in India [39]. Hypertension in type 2 diabetic patient commonly hordes with other cardiovascular risk factors such as microalbuminuria, central obesity, insulin resistance, dyslipidaemia, hypercoagulation, increased inflammation and left ventricular hypertrophy. This clustering eventually leads to the progression of CVD, which is the primary reason for premature mortality in type 2 diabetes patients [30]. When diabetes coexists with hypertension, the risk of CVD is augmented by 75%, which further adds to the overall morbidity and mortality rate [30, 40]. Cardiomyopathy, a unique myopathic state that appears to be independent of macrovascular/microvascular disease, contributes significantly to cardiovascular mortality and morbidity in diabetic patients, especially those with concurrent hypertension [30].

Cost effectiveness

The startling rise in the prevalence of diabetes and its complications has an impact on the costs of healthcare management in developing countries, especially in India. The annual expenditure of the Indian population for diabetes care was found to be 1541.4 billion INR (\$31.9 billion) in 2010. The median annual direct and indirect expenses associated with diabetes care were estimated to be 25,391 INR (\$525.5) and 4970 INR (\$102.8), respectively [41]. In terms of number and frequency, diabetic patients have three times more chances for hospitalisation than non-diabetic patients. The annual direct cost is more than double in people with diabetes who are hospitalised than who are not hospitalised. A study to assess the Direct Costs Incurred by type 2 diabetes mellitus patients for their treatment at a large tertiary-care hospital in Karnataka, India showed that 49% of the annual expenditure of the study patients was for the drugs and about 21% was for the expenses upon hospitalisation [42]. The disbursement of diabetes care further escalates in the presence of complications or co-morbidities. Another study from South India to evaluate the cost of medical care among type 2 diabetic patients with hypertension revealed that a diabetic patient with hypertension spent an average 1.4 times more than a diabetic patient without

hypertension [41]. The co-incidence of hypertension along with diabetes made a substantial impact on the expenditure pattern. There was a notable variation observed in the total median cost for inpatient procedures per hospitalisation among diabetic patients with and without hypertension (21,000 INR i.e. 500 US\$ and 18,650 INR i.e. 444 US\$, respectively). Length of hospital stay during the admission for diabetic patients with hypertension was also considerably higher than their counterpart without hypertension [41].

The coexistence of diabetes and hypertension is the leading cause of end-stage renal failure necessitating dialysis or transplantation. Earlier studies from South India to assess the direct expenditure involved for treating hospitalised type 2 diabetic patients with CKD in comparison with diabetic patients without any complications showed that diabetic patients with CKD spend more per hospitalisation than patients without any complications. The total median cost of diabetic patients with CKD on haemodialyses was significantly higher than other non-diabetic CKD patients. The total consultation fees and medicine cost in treating both diabetes and CKD were significantly higher for patients on renal transplantation [43]. As the disbursement for the treatment of ESRD is relatively high in developing countries like India, many patients are unable to avail optimal therapy. Almost 70% of the Indian population is in the below-poverty-line category, and although the cost spent on dialysis is comparatively cheaper than other countries, 90% of the Indians cannot afford it [43, 44]. Hence, identification of patients at high risk for diabetic nephropathy, prevention and early diagnosis is crucial to preclude the progression towards chronic kidney damage.

Strategies for better hypertension control

Although the pervasiveness of hypertension is frightening in developing countries like India, enforcement of proper guidelines and evidence-based scientific recommendations for effective management is still lacking in the country. Implementation of various strategies suggested by the World Heart Federation to prevent the incidence of uncontrolled hypertension [45] and execution of programmes like Global Standardised Hypertension Treatment Project [46] focusing on the reinforcement of health system are crucial in the present scenario. Barriers that thwart the hypertension management efforts should be identified and focused endeavours should be made to eliminate the roadblocks. Team-based care for hypertension management is the need of an hour and all healthcare professionals should be well trained about the management strategies. Societies should be educated about the importance of lifestyle modifications in hypertension management, which includes maintenance of appropriate body mass index, physical activity and

regulation of dietary salt consumption. Individuals should also be encouraged to screen their hypertension status frequently to manage the condition early. Standardised treatment approaches, which stipulate recommendations for the use of mono, combo and polydrug therapy should be specifically formulated for the developing countries. Persistent efforts should be made to ensure the availability of low-cost generic drugs as well as the adherence of patients to the drug treatment. Introduction of mandatory nationwide free healthcare and assurance programmes may provide a better solution to improve the current situation [47].

Conclusion

SES, availability of healthcare options and awareness about disease prevention and control play a major role in the prevalence of diabetes and hypertension as well as its coexistence. Indian states with greater urbanisation and social development exhibit a higher prevalence rate of diabetes as well as hypertension. The healthcare system in India should focus on better hypertension screening and control, especially in diabetic patients, to reduce the complications. Relentless efforts to ensure the public awareness, availability of low-cost generic drugs as well as the adherence of patients to the drug treatment, implementation of evidence-based standardised treatment modalities and nationwide free health assurance programmes could ease the severity and progression of these non-communicable diseases.

Study highlights

- Socioeconomic status, availability of healthcare options, and awareness about disease prevention and control play a major role in the prevalence of diabetes and hypertension as well as its coexistence.
- Even though hypertension has been proven to have critical involvement in the development of microvascular complications in persons with diabetes, awareness about the prevention, treatment and control of these diseases remains alarmingly low in developing countries like India.
- The health-care system in India should focus on better hypertension screening and control, especially in diabetic subjects, to reduce the complications.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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