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Original Article

Control of hypertension among teachers in schools in Kerala (CHATS-K), India

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ABSTRACT

Objective: We investigated the prevalence, awareness, treatment, control of hypertension and the factors associated with hypertension prevalence and control among school teachers in Kerala, India.
Methods: We surveyed 2216 school teachers in Thiruvananthapuram district of Kerala as part of the control of hypertension among teachers in schools in Kerala (CHATS-K), India. We used World Health Organization STEPS tools for non-communicable diseases risk factor surveillance. Blood pressure, weight and height were measured using standard protocols. Hypertension was defined as systolic blood pressure (SBP) $\geq$ 140 mmHg and/or diastolic blood pressure (DBP) $\geq$ 90 mmHg, or self-reported current anti-hypertensive medication. Controlled hypertension was defined as SBP<140 and DBP<90 mmHg. Separate multivariate analysis was done for finding the associated factors with prevalence and control of hypertension.
Results: Age adjusted hypertension prevalence was 14.6%. Men, those with self-reported diabetes, having family history of hypertension and overweight were more likely to have higher prevalence of hypertension compared to their counterparts. Among hypertensives 62% were aware, 49% on treatment and 34% achieved adequate control. Hypertension control was significantly higher among women, diabetics and overweight individuals compared to their counterparts.
Conclusions: A higher level of hypertension control among school teachers in this study indicates an attainable level of hypertension control in the general population of the state. Teachers, with their highly regarded place in the social construct of the country and the state, could thus be used as role models for hypertension control for the general population in the state.

1. Introduction

Hypertension (HTN), a known precursor to cardiovascular disease, has emerged as a leading cause of global morbidity and mortality. The global prevalence of HTN has been on the rise, and World Health Organization (WHO) has estimated that currently, more than 1 billion people have hypertension and two third of them are living in low and middle income countries (LMIC).[1] According to the global burden of disease (GBD) study in 2017, high systolic blood pressure (SBP) had claimed over 10.4 million lives and 218 million disability-adjusted life years (DALY). Overall, 9% of the total DALYs were attributable to high SBP.[2] A study by Non Communicable Disease Risk Factor Collaboration (NCD-RISC) reported an upsurge in the global number of adults with hypertension from 594 million in 1975 to 1.13 billion in 2015.[3] This increase in the number of hypertensives, however, was observed mainly in South Asia and East Asian countries, showing a shift of the disease from the high-income to LMIC.[3] It is estimated that by 2025, 1.15 billion hypertensives will be from economically developing countries, thus contributing about three-fourths of hypertensives globally.[4]

The global burden of hypertension study reported 199 million Indians suffering from hypertension in 2015.[3] There is a rising trend

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of hypertension prevalence in India. However, the control rate of hypertension remains inadequate. Of importance is not just the prevalence but also the control amongst the treated hypertensives. The Kaiser Permanente Northern California program in the United States increased the hypertension control in its population from 44% to 90% during the period 2000–2013 and averted 24% deaths from heart attacks and 42% deaths from stroke.[5] Gupta et al estimated that controlled hypertension could prevent around 4,00,000–5,00,000 deaths annually of the 1.64 million deaths attributable to hypertension in India.[6] Prospective Urban Rural Epidemiology (PURE) study on cardiovascular diseases in 17 countries reported a 50% control of hypertension in high-income countries whereas the control rate was reported to be 13% in low and middle-income countries.[7] The control rate of hypertension was reported as 15% in urban and 9% in rural areas in South Asia.[8] Treatment and control rates of hypertension are varying in different parts of India.[9] In a meta-analysis, Anchala et al reported a hypertension control rate of 20.2% in urban and 10.7% in rural areas of India.[10]

Several studies have reported a cause-effect relationship between job strain and high blood pressure.[11,12] A study among bank employees in Maharashtra state of India reported a hypertension prevalence of 42%[13] whereas another study in workers of ammunition factory in western part of India reported a hypertension prevalence of 43%.[14] A Chinese study among the working population reported 23% hypertension prevalence and 8.5% control rate of hypertension.[15] Teachers are not just educators; they can be role models as they play a vital role in the overall development of students. With proper knowledge, teachers have the power to educate the general community at large.[16]

A few studies reported a susceptibility of teachers to develop hypertension due to work-related risk factors like unhealthy diet, overweight, obesity, and lack of physical activity.[17] Findings from Bangladesh showed a hypertension prevalence of 52% among schoolteachers.[18] Studies among schoolteachers across India have reported a prevalence of hypertension of 45.4% in the state of Assam,[19] 28.6% in Karnataka[20] and 24% in Telangana.[17] No such studies have been reported from Kerala state of India, which has the highest rates of cardiovascular diseases in India.[21,22] The present study aims to investigate the prevalence, awareness, treatment, and control of hypertension and the factors associated with hypertension prevalence and control among schoolteachers in Kerala, India.

2. Methods

This study is based on the baseline cross-sectional survey conducted as part of the control of hypertension among teachers in schools in Kerala (CHATS-K), India. This was done among 2216 school teachers aged 30–55 years in 2018. Of the 900 schools (government and government-aided) in the Thiruvananthapuram district of Kerala, we randomly selected 92 schools. Teachers were surveyed in these 92 schools using WHO STEPS protocol.[23] The study methodology was published elsewhere with the details of sample selection.[24] The overall response rate was 98%.

We collected behavioural and anthropometric data using the World Health Organization (WHO) STEPS instrument for NCD risk factor surveillance. We collected demographic details of age, sex, education, and marital status; behavioural risk factors like, tobacco use, alcohol consumption, and family history of hypertension using an interview schedule. Current tobacco use was defined as teachers who used any form of tobacco one month before the survey, and current alcohol use defined as those who consumed any alcoholic drink within the past 30 days. The family history of hypertension was assessed by asking the question “Have any of your close relatives (mother, father, brothers, sisters, grandparents) been told that they had high blood pressure (hypertension)?”

Details on self-reported diabetes were also collected. All the teachers for the study were interviewed at their schools by trained field investigators under the supervision of the main researcher.

We measured weight using portable electronic weighing scale (Model HN 283, Omron Corporation, Shimogyo-ku, Kyoto, Japan) and height using stadiometer (Model 206, Seca, Hamburg Germany) according to WHO STEPS protocol.[23] Blood pressure was measured using a digital Omron blood pressure apparatus (OMRON-4, Omron Corporation, Kyoto, Japan). Blood Pressure (BP) was measured thrice after the patient had rested for at least 5 min in a quiet, comfortable position. The average of the last two readings was used as the final BP reading of that individual. Self-reported use of anti-hypertensive drugs was also collected. Insufficient physical activity was defined as not meeting the recommendation of 150 min of moderate aerobic physical activity, or 75 min of vigorous aerobic physical activity, or an equivalent combination, achieving at least 600 metabolic equivalent minutes per week.[25] Body Mass Index (BMI) was calculated asweight in kilograms divided by height in meters squared. Overweight was defined as BMI$\geq$25 kg/m^2. Hypertension was defined as systolic BP $\geq$ 140 and/or diastolic BP $\geq$ 90 or on medication for hypertension. Classification of blood pressure was done based on JNC-VII criteria [Normal: SBP <120 and DBP <80, Prehypertension: SBP 120–139 or DBP 80–89, Stage 1 Hypertension: SBP: 140–159 or DBP: 90–99, Stage 2 Hypertension: SBP $\geq$160 or DBP$\geq$100]. Controlled hypertension was defined as SBP<140 and DBP<90 mmHg.

Data analysis was done using SPSS version 21.0. The minimum statistical significance level was fixed as $p < 0.05$. Odds Ratios (OR) presented are based on multivariate analysis using multiple logistic regression model. Age adjusted hypertension prevalence was calculated based on the standard WHO world population.

The study was approved by the institute ethics committee of Sree Chitra Tirunal Institute for Medical Science and Technology, Trivandrum, India.

3. Results

The mean age of the study participants was 44 years (range: 30–55 years), 16% were men, 92% were currently married, 62% post graduates and 62% reported a family history of hypertension. Nearly half (49%) were from government schools. The self-reported doctor-diagnosed diabetes was 11%.

The age adjusted prevalence of hypertension was found to be 14.6%. Among the total sample population, 53% had normal blood pressure, more than one fourth (29%) had pre-hypertension. Among the hypertensives 34% had controlled hypertension, 53% had stage 1 and 13% had stage 2 hypertension according to JNC VII criteria. The pattern of different levels of hypertension by sex is presented in Table 1.

Table 2 gives details of findings of bivariate and multivariate analysis of prevalence of hypertension by background characteristics. Older adults, men, overweight individuals, those who reported diabetes and those who reported family history of diabetes were more likely to have hypertension compared to their counterparts.

Awareness and treatment of hypertension by background characteristics are presented in Table 3. Among hypertensives, 62% were aware and 49% were on treatment. Awareness was higher for those who were overweight and those who reported diabetes. Older adults, women, overweight individuals, those with family history of hypertension and those who reported diabetes were more likely to be on treatment for hypertension compared to their counterparts.

Table 1
Distribution of blood pressure in the study sample: JNC VII Stages.

Variable	Non-hypertensives N (%)		Hypertensives N (%)		
	Normal BP[a]	Pre-hypertension[b]	Controlled[c]	Stage 1- hypertension[d]	Stage 2- hypertension[e]
Total ($n = 2216$)	1169(52.8)	645(29.1)	137(6.2)	214(9.6)	51(2.3)
Men ($n = 357$)	113(31.6)	126(35.3)	26(7.3)	70(19.6)	22(6.2)
Women($n = 1859$)	1056(56.8)	519(27.9)	111(6.0)	144(7.7)	29(1.6)

(percentages presented are row percentage).
[a] SBP<120 and DBP<80.
[b] SBP 120–139 or DBP 80–89.
[c] SBP < 140 and DBP <90 and on medication for hypertension.
[d] SBP 140–159 or DBP 90–99.
[e] SBP≥160 or DBP ≥ 100.

Table 2
Prevalence of hypertension (HPTN) by background characteristics: Results of bivariate and multivariate analysis.

Characteristics	Prevalence of HPTN N(%)	OR (95% CI)	*p* value (multivariate analysis)
Age	*		
30-44	116(10.6)	Reference	
45-55	286(25.6)	2.82(2.21–3.60)	<0.001
Sex	*		
Women	284(15.3)	Reference	
Men	118(33.1)	2.93(2.20–3.89)	<0.001
Overweight	*		
No	76(13.1)	Reference	
Yes	326(19.9)	1.78(1.33–2.37)	<0.001
Inadequate physical activity	*		
Yes	282(16.7)	Reference	
No	120(22.9)	1.22(0.94–1.58)	0.125
Tobacco or alcohol use	*		
No	372(17.6)	Reference	
Yes	30(28.3)	1.05(0.64–1.72)	0.828
Self-reported Diabetes	*		
No	322(16.3)	Reference	
Yes	80(34.0)	2.19(1.60–3.00)	<0.001
Family history of hypertension	*		
No	105(12.5)	Reference	
Yes	297(21.6)	2.07(1.61–2.67)	<0.001

Hypertension: SBP ≥ 140 or DBP ≥ 90 or on medication for hypertension.
*$p < 0.05$ in bivariate analysis.

Table 3
Awareness and treatment of hypertension among hypertensives by background characteristics ($n = 402$).

Characteristics	Aware N(%)	Treated N(%)
Age		*
30-44	65(56.0)	46(39.7)
45-55	185(64.7)	152(53.1)
Sex		*
Men	69(58.5)	47(39.8)
Women	181(63.7)	151(53.2)
Overweight	*	*
No	38(50.0)	29(38.2)
Yes	212(65.0)	169(51.8)
Inadequate physical activity		
No	77(64.2)	56(46.7)
Yes	173(61.3)	142(50.4)
Tobacco or alcohol use		
No	234(62.9)	185(49.7)
Yes	16(53.3)	13(43.3)
Diabetes	*	*
No	191(59.3)	145(45.0)
Yes	59(73.8)	53(66.2)
Family history of hypertension		*
No	58(55.2)	43(41.0)
Yes	192(64.6)	155(52.2)
Total	**250(62.2)**	**198(49.3)**

*$p < 0.05$.

Among all hypertensives, controlled hypertension was 34%. Among treated hypertensives, the control rate was 69%. Findings of bivariate and multivariate analysis of control of hypertension among all hypertensive are presented in Table 4. Control of hypertension was higher for older people (37.4%) compared to younger people (25.9%). In multivariate analysis, women, those who were overweight and those reported diabetes were two times more likely to have achieved hypertension control compared to their counterparts when adjusted for age, physical activity, tobacco or alcohol use and family history of hypertension.

4. Discussion

To our knowledge, this study is the first comprehensive study using standard protocols on hypertension among school teachers in the state. The present study found 14.6% prevalence of hypertension, which was much lower than that reported from general population (30%) in the state.[26] School teachers in Saudi Arabia[27] reported a hypertension prevalence of 25%. Consistent with prior findings,[13,28] our study had a higher prevalence of hypertension among older adults. Hypertension prevalence in the age group of 45–54 years (39.8%) reported from general population in India[29] was higher than the present study results of 25.6% hypertension prevalence in the same age group. A nationally representative study among 1.3 million adults (18 years and above) in India reported a hypertension prevalence of 25.3%.[30]

Table 4
Control of hypertension by background characteristics: Results of bivariate and multivariate analysis.

Characteristics	Control rate N(%)	OR (95% CI)	*p* value (multivariate analysis)
Age	*		
30-44	30(25.9)	Reference	0.056
45-55	107(37.4)	1.63(0.98–2.70)	
Sex	*		
Men	26(22.0)	Reference	0.037
Women	111(39.1)	1.80(1.03–3.13)	
Overweight	*		
No	16(21.1)	Reference	0.040
Yes	121(37.1)	1.90(1.03–3.53)	
Inadequate physical activity	*		
Yes	104(36.9)	Reference	0.274
No	33(27.5)	0.75(0.45–1.24)	
Tobacco or alcohol use			
No	130(34.9)	Reference	0.561
Yes	7(23.3)	0.75(0.29–1.95)	
Self-reported Diabetes	*		
No	98(30.4)	Reference	0.007
Yes	39(48.8)	2.03(1.20–3.41)	
Family history of hypertension			
Yes	31(29.5)	Reference	0.375
No	106(35.7)	1.25(0.75–2.07)	

Control of hypertension: SBP<140 and DBP<90 mmHg among those with hypertension.
*$p < 0.05$ in bivariate analysis.

More than one-fourth (29%) of the study population reported pre-hypertension in this study. Similar prevalence (30%) was reported from a representative cohort of over 16,000 adults in three cities of South Asia.[31] However, several other studies reported a higher prevalence of individuals with pre-hypertension. Suma et al reported a pre-hypertension prevalence of 40.9% in Northern Kerala,[28] whereas another study from Kerala reported a prevalence of 43.7%.[32] A pre-hypertension prevalence of 36% was reported among school teachers from Karnataka state of India.[33] Another study from Saudi Arabia reported a prevalence of 43% among school teachers.[27]

A systematic review and meta-analysis of hypertension reported that 25% of rural and 42% of urban Indians were aware of their hypertension.[10] Those who were aware on hypertension (62%) and were on treatment for hypertension (49%) were comparatively higher in our study than the general population in the state (awareness 37%; treated hypertensives: 27%).[21] Lower age, higher level of education and economic stability of the present study participants could be the reasons for their higher awareness and treatment of hypertension.

Hypertension and diabetes are known to develop concurrently.[34] Moreover, individuals with high blood pressure have a higher risk of developing type-2 diabetes mellitus.[35] We found a higher prevalence of hypertension among those who reported diabetes similar to the Hypertension in Diabetes Study (HDS) in the United Kingdom that reported a prevalence of 39% of hypertension among diabetics.[36] A study from Saudi Arabia reported that 56% of the patients attending Primary Health Care Clinics were both hypertensives and diabetics.[37] A multi-state study in India reported a prevalence of co-existing Diabetes and Hypertension in 60% of the total 1420 participants.[38] As reported earlier,[39] hypertension prevalence in our study was significantly higher in those with a family history of hypertension. In concurrence with earlier findings, overweight was a significant risk factor for hypertension.[40]

Hypertension control in our study was significantly higher among women (37.4%) when compared to men (22%). A higher rate of controlled hypertension among women than men was also reported from the general population of Kerala.[21] A study in the United States reported that a higher percentage of women had controlled hypertension (56.3%) than men (50.6%). Better compliance with treatment could be a reason. A better hypertension control among teachers with self reported diabetes in our study (49%) was higher than that reported among diabetes from Tanzania (15.5%)[41] and Malaysia (23.5%).[42]

Our control rate of 69.2% among treated hypertensives is one of the highest rates reported from low- and middle-income countries. This might be due to the lower mean age of the present study population and could also be credited to the high literacy among the study subjects that comprised of mainly graduates and postgraduates.[43]

Due to the increasing overall burden of hypertension in the state as well as in India, these findings emphasize the importance of controlling hypertensionand a high level of control among schoolteachers found in this study indicates an attainable level of control of hypertension in the general population of the state. Teachers, with their highly regarded place in the social construct of the country and the state, could thus be used as role models for hypertension control for the general population in the state.

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Authors' contribution

GKM is the principal investigator and conceived the study. PSS and KRT are the advisor of the study and participated in the design and intervention of the study. CP was involved in analysis and interpretation of data and critically reviewing the draft paper. GKM wrote the first draft of the manuscript. All authors provided intellectual input to the manuscript and approved the final version of the manuscript.

Declaration of competing interest

The authors declare that they have no conflict of interest.

References

1. World Health Organization. Hypertension: key facts. https://www.who.int/news-room/fact-sheets/detail/hypertension. Accessed on January 10, 2020.
2. Stanaway JD, Afshin A, Gakidou E, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2018 Nov 10;392:1923–1994.
3. Zhou B, Bentham J, Di Cesare M, et al. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19.1 million participants. *Lancet*. 2017 Jan 7;389(10064):37–55.
4. Kerney MP, Megan W, Reynolds K, et al. Global burden of hypertension: analysis of worldwide data. *Lancet*. 2005 Jan 15-21;365:217–223.
5. Jaffe MG, Young JD. The kaiser Permanente northern California story: improving hypertension control from 44% to 90% in 13 Years (2000 to 2013). *J Clin Hypertens (Greenwich)*. 2016 Apr;18(4):260–261.
6. Gupta R, Xavier D. Hypertension: the most important non communicable disease risk factor in India. *Indian Heart J*. 2018 Jul - Aug;70(4):565–572.
7. Chow CK, Teo KK, Rangarajan S, et al. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *J Am Med Assoc*. 2013 Sep 4;310(9):959–968.
8. Gupta R, Kaur M, Islam S, et al. Association of household wealth index, educational status, and social capital with hypertension awareness, treatment, and control in South Asia. *Am J Hypertens*. 2017 Apr 1;30(4):373–381.
9. Gupta R. Convergence in urban-rural prevalence of hypertension in India. *J Hum Hypertens*. 2016 Feb;30(2):79–82.
10. Anchala R, Kannuri NK, Pant H, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens*. 2014 Jun;32(6):1170–1177.
11. Schnall PL, Schwartz JE, Landsbergis PA, et al. Relation between job strain, alcohol, and ambulatory blood pressure. *Hypertension*. 1992 May;19(5):488–494.
12. Kawakami N, Haratani T, Araki S. Job strain and arterial blood pressure, serum cholesterol, and smoking as risk factors for coronary heart disease in Japan. *Int Arch Occup Environ Health*. 1998 Sep;71(6):429–432.
13. Brahmankar TR, Prabhu PM. Prevalence and risk factors of hypertension among the bank employees of Western Maharashtra – a cross sectional study. *Int J Community Med Publ Health*. 2017 Apr;4(4):1267–1277.
14. Gupta A, Goyal N, Jindal AK, et al. Study of lifestyle diseases among workers of an ammunition factory. *J Mar Med Soc*. 2017;19(1):43–47.
15. Shen Y, Wang X, Wang Z, et al. Prevalence, awareness, treatment, and control of hypertension among Chinese working population: results of a workplace-based study. *J Am Soc Hypertens*. 2018 Apr;12(4):311–322.e2.
16. World Health Organization. *School Health Promotion: Report of an Inter-country Workshop Bangkok, Thailand*. vol. 2006. 2008:6–7. http://apps.searo.who.int/PDS_DOCS/B3358.pdf.
17. Darbastwar M, Ramkumar T, Madhusudan M, et al. A study of prevalence of risk factors of hypertension among school teachers in Central Telangana. *J Evid Based Med Healthc*. 2015 Dec;2(58):8935–8939.
18. Barua R, Alam M, Parvin N, et al. Prevalence of hypertension and its risk factors among school teachers in Dhaka, Bangladesh. *Int J Res Med Sci*. 2018 Sept;6(9):2902–2910.
19. Chetia D, Gogoi G, Baruah R. Hypertension and occupational stress among high school teachers of Dibrugarh district. *Int J Community Med Publ Heal*. 2018 Jan;5(1):206–209.
20. Girish B, Sumanth MM. A study of hypertension & its risk factors among primary school teachers of Tumkur, Kanataka. *Indian J Forensic Community Med*. 2017 Jan-Mar;4(1):53–57.
21. Thankappan KR, ShahB, Mathur P, et al. Risk factor profile for chronic non-communicable diseases: results of a community-based study in Kerala, India. *Indian J Med Res*. 2010 Jan;131(1):53–63.
22. Krishnan MN, Zachariah G, Venugopal K, et al. Prevalence of coronary artery disease and its risk factors in Kerala, South India: a community-based cross-sectional study. *BMC Cardiovasc Disord*. 2016 Jan 14;16:12.
23. World Health Organization. STEPwise approach to surveillance (STEPS). http://www.who.int/chp/steps/en/. Accessed January 13, 2020.
24. Mini GK, Sarma PS, Thankappan KR. Cluster randomised controlled trial of behavioural intervention program: a study protocol for control of hypertension among teachers in schools in Kerala (CHATS-K), India. *BMC Publ Health*. 2019 Dec 21;19(1):1718.
25. World Health Organization. Global Physical Activity Questionnaire (GPAQ): Analysis. Guide. https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf. Accessed January 20, 2020.
26. Sarma PS, Sadanandan R, Thulaseedharan JV, et al. Prevalence of risk factors of non-communicable diseases in Kerala, India: results of a cross-sectional study. *BMJ Open*. 2019 Nov 10;9(11), e027880.
27. Ibrahim NK, Hijazi NA, Al-Bar AA. Prevalence and determinants of pre-hypertension and hypertension among preparatory and secondary school teachers in jeddah. *J Egypt Publ Health Assoc*. 2008;83(3-4):183–203.
28. Suma RK, Mayamol TR, Binoo D, et al. Hypertension: prevalence, awareness, treatment and control in a rural area of North Kerala, India. *Int J Community Med Publ Health*. 2017 Oct;4(10):3561–3567.
29. Ramakrishnan S, Zachariah G, Gupta K, et al. Prevalence of hypertension among Indian adults: results from the great India blood pressure survey. *Indian Heart J*. 2019 Aug;71(4):309–313.
30. Geldsetzer P, Manne-oehler J, Theilmann M, et al. Diabetes and hypertension in India: a nationally representative study of 1.3 million adults. *JAMA Intern Med*. 2018 Mar;178(3):363–372.
31. Prabhakaran D, Jeemon P, Ghosh S. Prevalence and incidence of hypertension: results from a representative cohort of over 16,000 adults in three cities of South Asia. *Indian Heart J*. 2017 Jul - Aug;69(4):434–441.
32. Sebastian NM, Jesha MM, Haveri SP, et al. Hypertension in Kerala: a study of prevalence, control, and knowledge among adults. *Int J Med Sci Publ Health*. 2016;5:2041–2046.
33. Manjula D, Sahu B, Sasikumar NS, et al. Prevalence of Hypertension in school teachers of Bengaluru. *RGUHS Natl J Publ Health*. 2016 Apr;1(2):42–48.
34. Cheung BM, Li C. Diabetes and hypertension: is There a common metabolic pathway? *Curr Atherosclerosis Rep*. 2012 Apr;14(2):160–166.
35. Emdin CA, Anderson SG, Woodward M, et al. Usual blood pressure and risk of new-onset diabetes evidence from 4.1 million adults and a meta-analysis of prospective studies. *J Am Coll Cardiol*. 2015 Oct 6;66(14):1552–1562.
36. Hypertension in Diabetes Study (HDS): I. Prevalence of hypertension in newly presenting type 2 diabetic patients and the association with risk factors for cardiovascular and diabetic complications. *J Hypertens*. 1993 Mar;11(3):309–317.
37. Khalid SA, Samia AB, Bandari KA. Hypertension in Saudi adults with type 2 diabetes. *Interventions Obes Diabetes*. 2018 May 10;1(4):82–86.
38. Joshi SR, Saboo B, Vadivale M, et al. Prevalence of diagnosed and undiagnosed diabetes and hypertension in India-results from the screening India's twin epidemic (SITE) study. *Diabetes Technol Therapeut*. 2012 Jan;14(1):8–15.
39. Ranasinghe P, Cooray DN, Jayawardena R, et al. The influence of family history of Hypertension on disease prevalence and associated metabolic risk factors among Sri Lankan adults. *BMC Publ Health*. 2015 Jun 20;15:576.
40. Jiang SZ, Lu W, Zong X, et al. Obesity and hypertension. *Exp Ther Med*. 2016 Oct;12(4):2395–2399.
41. Kilonzo SB, Gunda DW, Bakshi FA, et al. Control of hypertension among diabetic patients in a referral hospital in Tanzania: a cross-sectional study. *Ethiop J Health Sci*. 2017 Sep;27(5):473–480.
42. Chew BH, Mastura I, Shariff-Ghazali S, et al. Determinants of uncontrolled hypertension in adult type 2 diabetes mellitus: an analysis of the Malaysian diabetes registry 2009. *Cardiovasc Diabetol*. 2012 May 18;11:54.
43. Veghari G, Sedaghat M, Maghsodlo S, et al. Impact of literacy on the prevalence, awareness, treatment and control of hypertension in adults in Golestan Province (northern Iran). *Caspian J Intern Med*. 2013 Winter;4(1):580–584.