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Research Article

Assessing the Prevalence of Hypertension among South Asian Adults: A Systematic Review and Meta-Analysis

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Abstract

Hypertension is a major modifiable risk factor for cardiovascular disease-related morbidity and mortality. It is growing rapidly in developing countries. South Asian adults of various sex and age groups are recognized as a high-risk population for hypertension. The objective of this systematic review and meta-analysis is to determine the prevalence and associated risk factors of hypertension in South Asian adults.

Articles for this systematic review and meta-analysis are limited to the South Asian adult population and were searched from electronic databases, such as PubMed, PMC, Google Scholar, and Scopus, where the search period was limited to January 2011 to December 2022. 28 studies were included through a multistage selection process. Hypertension was defined according to JNC 7 as SBP≥140 mmHg and/or DBP≥90 mmHg, taking antihypertensive medication, or prior diagnosis by healthcare professionals.

The total sample size of studies included was 348893, most of these studies collected data from participants over the age of 18 years. The heterogeneity in the prevalence of hypertension was shown by this systematic review and meta-analysis. The prevalence of high blood pressure ranged from 12.29% (95% CI: 10.49, 14.26) to 57.83% (95% CI: 54.93, 60.69). The average prevalence of hypertension among men and women was 29.12% (95% CI: 24.91, 33.51) and 28.18% (95% CI: 25.32, 31.15) respectively. Several studies have reported an association between hypertension and age, urban residence, literacy, diabetes, hypercholesterolemia, use of tobacco, sedentary lifestyles, central obesity, and high BMI.

Most of the studies of this systematic review and meta-analysis reported a prevalence of hypertension higher than 25%. Among South Asian adults both the highest (57.83%, 95%CI: 54.93, 60.69) and lowest (12.29%, 95%CI: 10.49, 14.26) prevalence of hypertension were reported from the studies in India. This meta-analysis showed the prevalence of hypertension among South Asian adults varied between and within the countries. South Asian adult populations need urgent public health intervention to reduce the burden of hypertension through increased awareness and healthcare access.

Keywords: Hypertension; South Asians; Adults; Meta-Analysis

Introduction

Hypertension, commonly known as high blood pressure, is one of the major global public health issues and its prevalence is growing rapidly in developing [1] and low- and middle-income countries [2]. According to the standard guidelines hypertension is defined as Systolic Blood Pressure (SBP) ≥ 140 mmHg and/or Diastolic Blood Pressure (DBP) ≥ 90 mmHg [3]. Hypertension is one of the most important modifiable risk factors for cardiovascular disease-related morbidity and mortality regardless of age and sex [4]. Cardiovascular diseases (CVDs), mainly ischemic heart disease (IHD) and stroke are the leading cause of mortality worldwide and a major contributor to disability. The prevalent cases of CVD nearly doubled from 271 million (95% uncertainty interval (UI): 257 to 285 million) in 1990 to 523 million (95% UI: 497 to 550 million) in 2019, and CVD deaths have continued to increase since 1990, 12.1 million (95% UI: 11.4 to 12.6 million) in 1990, reaching 18.6 million (95% UI: 17.1 to 19.7 million) in 2019 [5]. According to a report published in 2023 by the World Heart Federation (WHF), global deaths from CVD jumped to 20.5 million in 2021 [6].

The World Health Organization (WHO) estimates that hypertension is significantly responsible for approximately 62% of cerebrovascular disease and 49% of IHD worldwide. The risks of stroke and coronary heart disease (CHD) are also associated with both the levels of SBP and DBP [7]. Hypertension ranks as the second leading risk factor for men and the leading risk factor for women worldwide, accounting for approximately 90 million disability-adjusted life years (DALYs) in women and approximately 125 million DALYs in men [8]. Over the past two decades, the prevalence of hypertension in low and middle-income countries (LMCs) has been estimated to be higher than in high-income countries (HICs) with low levels of awareness, treatment, and control [4,9].

Among all WHO regions, the African region has the highest prevalence of hypertension (46%) and the lowest was reported from the region of America (35%). A total of 36% of South East Asian adults were hypertensive [10]. Again, adults regardless of sex from the South Asian region are recognized as a high-risk population for elevated blood pressure. South Asia spanning countries like India, Pakistan, Bangladesh, Sri Lanka, Nepal, and Bhutan. The region has a diverse population, unique genetic makeup, lifestyle, dietary, and cultural factors that contribute to the prevalence of hypertension. Afghanistan and the Maldives are often considered part of South Asia as well. In India, a study revealed that approximately 207 million people are living with high blood pressure [11]. In India, the overall prevalence of hypertension in adults is about 30% with 34% in urban and 28% in rural areas [8]. In Sri-Lanka and Bangladesh, 28.2% and 26.4% of adults respectively are hypertensive [12,13]. In Nepal, the prevalence was 28.4% (22.4–34.7), 25.5% (21.4–29.8), and 24.4% (17.9–31.6) among urban, suburban, and rural populations, respectively [14]. Again, the prevalence of hypertension in the Pakistani population above 15 years of age is 18%, its prevalence in the rural population is 16.2% and the urban population is 21.6% [15]. In Bhutan, a study found, the national prevalence of hypertension was 17.4% with females constituting 62.3% of the study population. About 11.4% of hypertensive patients are older than 64 years. The study also showed that 76.7% of hypertensive people lived in rural Bhutan [16]. High incidence of metabolic syndrome and lifestyle-related factors such as obesity, extra intake of salt, faulty diet, and low physical activity are important factors of hypertension in South Asia.

The objective of this systematic review and meta-analysis is to estimate the prevalence of hypertension in adults in South Asian countries and to investigate the associated risk factors reported by these studies.

Methods

This 'systematic review and meta-analysis' was performed by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 guidelines [17]. Articles for this review study had three main inclusion criteria; firstly full-text population-based cross-sectional studies published in peer-reviewed journals, secondly studies published between January 2011 and June 2023 in the English language, and studies reporting on the prevalence of hypertension among South Asian adults.

Of the 157 studies, 129 studies were excluded because they were review studies, followed a non-cross-sectional approach, reported miscalculations, and unavailability of the full text. 78% of articles stated that institutional ethical approval was obtained; individual consent was obtained in 10% of articles. Three articles reported that ethical approval was not required, as they used secondary data from a national health survey.

Articles were searched through a multistage selection process. In the first stage, a search of the electronic databases viz. PubMed, PubMed Central, Google Scholar, and Scopus, were performed with a compound of medical subject headings (MeSH) terms– 'hypertension', 'South Asian adults' and 'Prevalence'. The MeSH were combined with Boolean Operators like 'of', 'and' and 'among'. The search limits were, language ('English'), dates (between '1st January 2011' and '30th June 2023'), and species ('Humans'). Besides this, the search result was limited adding the name of each South Asian country name (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri-Lanka) and South Asia as keywords. This study included only articles from studies that had a sample size of at least 1000 or more and included both men and women aged 15 years and over.

The PRISMA diagram (Figure 1) illustrates the selection process and shows the reasons for exclusion. 28 of 157 articles that reported essential statistics on hypertension in adults in South Asia were selected for this systematic review and meta-analysis.

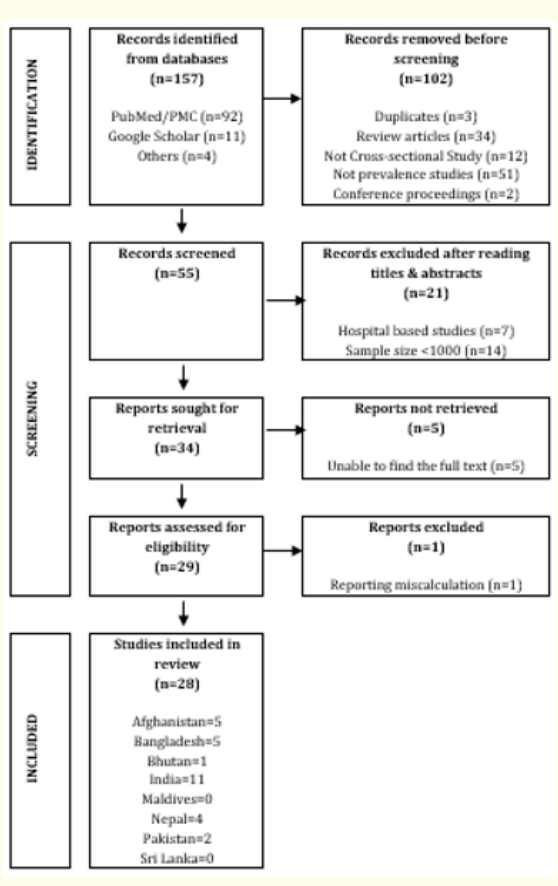

Figure 1: PRISMA diagram showing study selection for the prevalence of hypertension among south Asian adults.

All required data include country name, first author's name, year of publication, journal name, study type, study area, habitat (rural/urban), age and sex of participants, sample size, instruments, frequency and interval time for blood pressure measurement, prevalence of hypertension and associated risk factors was plucked using a MS excel worksheet. Hypertension was defined according to JNC 7 as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg, taking antihypertensive medication, or previously diagnosed by health care providers [18].

This meta-analysis was performed by 'MedCalc' (Version 20) software using fixed and random effects models to find the pooled prevalence of hypertension in selected studies. Prevalence data were reported with 95% confidence intervals (CI) and random effects weight in percentages [19]. Heterogeneity is defined as the disparity between fully formed elements. The most commonly used measure for heterogeneity, I^2 statistic, describes the percentage of variation across studies that is due to heterogeneity rather than chance [20]. Publication bias was calculated by the Funnel plot and Egger's test, which were performed to describe the unevenness of the distribution of selected studies [21]. Forest plots display effect estimates on the horizontal scale, and thus measure study size on the vertical axis.

Results

The summary of the study characteristics is presented in Table 1. It is evident that this systematic review and meta-analysis is based on 28 articles that followed the methodology, mentioned in the previous section, and reported the prevalence of hypertension in adults in South Asia are selected for this systematic review and meta-analysis. The majority of selected articles were from India (N = 11) followed by Afghanistan (N = 5), Bangladesh (N = 5), Nepal (N = 4), Pakistan (N = 2), and Bhutan (N = 1). This systematic review did not include any studies from Maldives and Sri-Lanka, due to the unavailability of the study as per criterion.

The highest number of studies (N = 5) were published in 2017 followed by 2021 (N = 4). A total of 9 studies collected data on blood pressure from urban areas followed by 8 studies from rural areas. Eleven studies collected data from both urban and rural areas in South Asia but did not present separately. The total sample size included in this systematic review and meta-analysis was 348893, ranging from 1061 to 180335. Most studies (N = 13) collected data from participants over the age of 18, followed by those above 20 years (N = 5) and 25 years (N = 4). For measurement of blood pressure, a digital blood pressure monitor was used by

the highest number of studies (N = 13) followed by 9 studies, that used manual mercury sphygmomanometers. Six studies did not provide information about the blood pressure measuring devices. The frequency of blood pressure measurement varies from 2 to 3 intervals, with time ranging from 2 to 10 minutes. 5 studies did not provide information about the frequency of measurement, whereas 11 studies did not mention interval time for blood pressure measurement. The highest 20 studies classified hypertensive participants based on SBP≥140 mmHg and/or DBP≥90 mmHg or taking antihypertensive medication. Only 8 studies considered SBP≥140 mmHg and/or DBP≥90 mmHg as hypertension.

Country	Area/Region	Habitat Rural/Urban	n	Age (yrs)	BP Instrument	Frequency of Measurement	Interval time (mins)	Hypertension Definition	Author and Year
Afghanistan	Kabul	Urban	1183	≥40	Digital	2	NR	≥140/90 or medicine	Saeed., *et al*. 2014 [22]
	Jalalabad	Urban	1180	25-64	Manual	2	5	≥140/90 or medicine	Saeed K.M.I., 2015 [23]
	Kabul	Urban	1172	≥25	NR	NR	NR	≥140/90	Saeed K.M.I., 2017 [24]
	Kandahar	Urban	1165	25-70	NR	3	NR	≥140/90 or medicine	Saeed K.M.I., 2017 [25]
	Hirat	Urban	1129	25-70	Manual	3	5	≥140/90 or medicine	Saeed K.M.I., 2017 [26]
Bangladesh	Pan Bangladesh	Rural and Urban	7839	≥35	Digital	3	10	≥140/90 or medicine	Chowdhury., *et al*. 2016 [27]
	Sylhet	Rural	1810	≥35	Digital	3	10	≥140/90 or medicine	Khanam., *et al*. 2019 [28]
	6 Divisions	Rural and Urban	8019	18-69	NR	NR	NR	≥140/90	Simmons., *et al*. 2021 [29]
	Pan Bangladesh	Rural and Urban	12904	18-95	Digital	3	5	≥140/90 or medicine	Khan., *et al*. 2021 [30]
	Pan Bangladesh	Rural and Urban	11881	≥18	Digital	3	10	≥140/90 or medicine	Das., *et al*. 2022 [31]
Bhutan	Pan Bhutan	Rural and Urban	31066	≥18	NR	NR	NR	≥140/90 or medicine	Wangdi and Jamtsho, 2020 [16]

India	5 Regions	Urban	6106	20-75	Digital	3	NR	≥140/90 or medicine	Gupta., *et al*. 2013 [31]
	Jammu, J&K	Urban	1162	≥30	Manual	3	3	≥140/90 or medicine	Rani., *et al*. 2014 [33]
	Kolkata, West Bengal	Urban	10167	≥20	Manual	2/3	2	≥140/90 or medicine	Banerjee., *et al*. 2016 [34]
	Uttar Pradesh	Rural	1061	18-40	Manual	3	3	≥140/90 or medicine	Zafar., *et al*. 2017 [35]
	24 States and UTs	Rural and Urban	180335	≥18	Digital	2	3	≥140/90 or medicine	Ramak-rishnan., *et al*. 2019 [36]
	Kerala and Andhra Pradesh	Rural	11636	≥18	Digital	3	3	≥140/90 or medicine	Thrift., *et al*. 2020 [9]
	Kashmir	Rural	4038	≥20	Digital	3	3 to 5	≥140/90 or medicine	Ganie., *et al*. 2021 [37]
	West Bengal	Rural	1296	21-60	NR	NR	NR	≥140/90	Datta P.S., 2021 [38]
	Maharash-tra	Rural	2196	≥18	Manual	2/3	3	≥140/90	Vinay., *et al*. 2012 [39]
	Rajasthan	Rural and Urban	1560	≥18	NR	2	10	≥140/90	Damor., *et al*. 2022 [3]
	Kerala	Rural and Urban	1221	20-39	Digital	3	3	≥140/90 or medicine	Geevar., *et al*. 2022 [8]
Nepal	Eastern Nepal	Rural and Urban	14006	≥20	Manual	NR	NR	≥140/90 or medicine	Sharma., *et al*. 2011 [40]
	Pan Nepal	Rural and Urban	2100	18-65	Digital	2	2	≥140/90	Koju., *et al*. 2015 [41]
	2 Districts	Rural	1243	≥18	Manual	3	NR	≥140/90	Sainju., *et al*. 2018 [42]
	Pan Nepal	Rural and Urban	13393	≥18	Digital	3	NR	≥140/90 or medicine	Gupta., *et al*. 2019 [43]
Pakistan	Karachi	Urban	4303	≥15	Digital	3	5	≥140/90	Safdar., *et al*. 2015 [44]
	Punjab	Rural	13722	≥18	Manual	2	NR	≥140/90 or medicine	Shafi and Shafi, 2017 [45]
BP-blood pressure, UT- Union Territories, NR- not reported, 'medicine' refers to the participants receiving antihypertensive medicine.									

Table 1: Characteristics of selected studies among South Asian adults.

Variability in prevalence of hypertension

The variability in prevalence of hypertension among South Asian adults reported from 2011 to 2023 is displayed in Table 2. There was heterogeneity in the prevalence of hypertension, based on the place of research and study design. The prevalence of hypertension ranged from 12.29% (95% CI: 10.49, 14.26) to 57.83% (95% CI: 54.93, 60.69). The mean prevalence of hypertension was found to be 28.48% (95% CI: 25.18, 31.90) by applying random effects with a significant level of heterogeneity among the studies (I^2 = 99.73%, P<0.0001). More than 67% of studies (N = 19) reported a prevalence of hypertension higher than 25% among South Asian adults. The average prevalence of hypertension among men was 29.12% (95% CI: 24.91, 33.51) with a significant level of heterogeneity among the studies (I^2 = 99.66%, P<0.0001). On the other hand, the average prevalence of hypertension among women was 28.18% (95% CI: 25.32, 31.15) with a significant level of heterogeneity among the studies (I^2 = 99.26%, P<0.0001). The highest (57.83%, 95% CI: 54.93, 60.69) and lowest (12.29%, 95% CI: 10.49, 14.26) prevalence of hypertension for both sexes, male and female were reported from the studies conducted in India [8,33]. Again, among adult men, the highest (66.67%, 95% CI: 62.25, 70.87) and lowest (13.10%, 95% CI: 10.93, 15.53) prevalence was reported from the studies from India [33,39]. Similarly, the highest (51.61%, 95% CI: 47.78, 55.42) and lowest (7.50%, 95% CI: 5.75, 9.59) prevalence of hypertension for women were also reported from the studies conducted in India [8,33].

Country	Author and Year	n	Prevalence %	95% CI	Weight (%) (Random)
Afghanistan	Saeed., *et al*. 2014 [22]	1183	46.15	43.28 to 49.04	3.54
	Saeed K.M.I., 2015 [23]	1180	28.39	25.83 to 31.06	3.53
	Saeed K.M.I., 2017 [24]	1172	32.34	29.66 to 35.10	3.53
	Saeed K.M.I., 2017 [25]	1165	32.27	29.59 to 35.04	3.53
	Saeed K.M.I., 2017 [26]	1129	35.61	32.81 to 38.48	3.53
Bangladesh	Chowdhury., *et al*. 2016 [27]	7839	25.72	24.75 to 26.70	3.60
	Khanam., *et al*. 2019 [28]	1810	18.73	16.96 to 20.60	3.56
	Simmons., *et al*. 2021 [29]	8019	21.16	20.24 to 22.07	3.60
	Khan., *et al*. 2021 [30]	12904	27.36	26.59 to 28.14	3.60
	Das., *et al*. 2022 [31]	11881	28.55	27.73 to 29.37	3.60
Bhutan	Wangdi and Jamtsho, 2020 [16]	31066	17.41	16.99 to 17.83	3.61
India	Gupta., *et al*. 2013 [31]	6106	42.76	41.52 to 44.01	3.60
	Rani., *et al*. 2014 [33]	1162	57.83	54.93 to 60.69	3.53
	Banerjee., *et al*. 2016 [34]	10167	42.33	41.37 to 43.30	3.60
	Zafar., *et al*. 2017 [35]	1061	17.72	15.47 to 20.15	3.53
	Ramakrishnan., *et al*. 2019 [36]	180335	36.06	35.84 to 36.28	3.61
	Thrift., *et al*. 2020 [9]	11636	29.73	28.91 to 30.57	3.60
	Ganie., *et al*. 2021 [37]	4038	41.41	39.88 to 42.94	3.59
	Datta P.S., 2021 [38]	1296	28.47	26.03 to 31.01	3.54
	Vinay., *et al*. 2012 [39]	2196	12.75	11.38 to 14.22	3.57
	Damor., *et al*. 2022 [3]	1560	25.32	23.18 to 27.56	3.55
	Geevar., *et al*. 2022 [8]	1221	12.29	10.49 to 14.26	3.54

Nepal	Sharma., *et al*. 2011 [40]	14006	34.03	33.25 to 34.83	3.60
	Koju., *et al*. 2015 [41]	2100	15.09	13.59 to 16.69	3.57
	Sainju., *et al*. 2018 [42]	1243	30.17	27.63 to 32.81	3.54
	Gupta., *et al*. 2019 [43]	13393	21.11	20.42 to 21.81	3.60
Pakistan	Safdar., *et al*. 2015 [44]	4303	17.66	16.53 to 18.83	3.59
	Shafi and Shafi, 2017 [45]	13722	35.07	34.27 to 35.87	3.61
	Total (random effects)	348893	28.48	25.18 to 31.90	100.00
Test for heterogeneity Egger's test		Publication bias			
		Begg's test			
Significance level	P<0.0001	Intercept	-8.83	Kendall's Tau	0.13
I^2 (inconsistency)	99.73%	95% CI	-19.42 to 1.75		
95% CI for I^2	99.71 to 99.75	Significance level	P = 0.0984	Significance level	P = 0.3043

Table 2: Variability of Prevalence of hypertension among South Asian adults.

The result of Egger's test for the funnel plot and Begg's test was both statistically non-significant for the presence of publication bias P = 0.098 and P = 0.304 respectively. Figure 3 shows the table 2 outcomes through forest plot and funnel plot respectively.

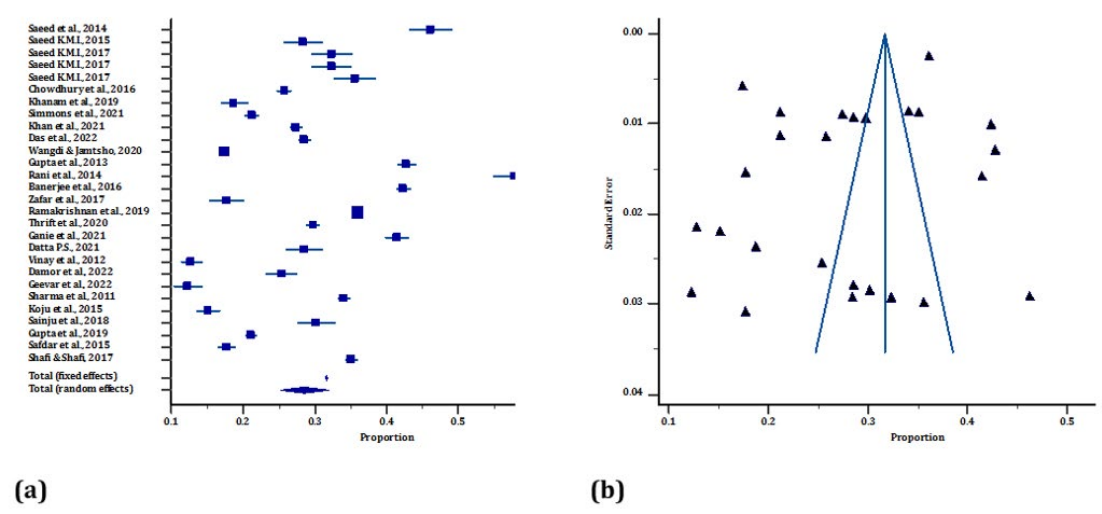

Figure 2: Distribution of studies included prevalence of hypertension among South Asian adults in the (a) forest plot and (b) funnel graph.

Risk factors of hypertension

Several studies have reported risk factors for hypertension among South Asian adults. Age is one of the most crucial non-modifiable risk factors for hypertension [24,30]. A study from Bangladesh revealed that the risk of hypertension was higher among adults aged ≥40 years. The study again revealed, females, aged ≥60 years were more than two and three-fold more prone to be hypertensive compared to adults in the younger age groups 18-39 and 40-59 years respectively [29]. A study from India [34] showed an age of more than 60 years whereas two studies from Afghanistan reported that age ≥50 years are associated with elevated blood pressure (OR 3.86, 95% CI: 2.86, 5.21; OR 3.42, 95% CI: 2.50, 4.76) [22,23]. Again, most of the studies found men are at higher risk than female, but, two studies [16,40] found the opposite results among adults in South Asia. Several studies mentioned association between hypertension and urban residence (OR 2.21, 95% CI: 1.52, 3.22) [8], literacy (OR 1.90, 95% CI: 1.05, 1.90) [22], family history of hypertension (OR 1.6, 95% CI: 1.4, 1.7) [37], diabetes (OR 1.75, 95% CI: 1.10, 2.79; OR 1.54, 95% CI: 1.31, 1.83) [23,27], family history of diabetes (OR 2.20, 95% CI: 1.30, 3.75) [22], hypercholesterolemia (OR 1.64, 95% CI: 1.12, 2.40) [8], smoking [23,35], use of tobacco [34], passive smoking (OR 1.3, 95% CI: 1.1, 1.5) [37], occupation [16] and sedentary lifestyles [22-24]. Beside this, studies also reported association between hypertension and obesity (OR 1.3, 95% CI: 1.1, 1.6; OR 2.1, 95% CI: 1.49, 2.94) [25,37], central obesity (OR 1.67, 95% CI: 1.23, 2.27; OR 1.74, 95% CI: 1.06, 2.87) [22,8], waist circumference [28,29], and higher BMI (OR 2.08, 95% CI: 1.50, 2.89; OR 2.19, 95% CI: 1.87, 2.57) [22,27].

Summary of findings

Table 3 summarizes the findings of studies reporting the prevalence of hypertension among South Asian adults. Pooled prevalence (random effects) and inconsistency value (I^2) with 95% CI are reported, including several pooled studies with sample size by country of study, sex, habitat, and year of publication. Afghanistan shows the highest prevalence (34.86%, 95% CI: 29.11, 40.85) of hypertension and a study from Bhutan shows the lowest prevalence of hypertension (17.41%, 95% CI: 16.99, 17.83) among South Asian countries. However, no studies from Maldives and Sri-Lanka were included in this meta-analysis, due to the unavailability of studies based on methodology. In the case of sex-wise differential prevalence, adult males show the highest prevalence of hypertension i.e. 29.12% (95% CI: 24.91, 33.51) than their female counterparts (28.18%, 95% CI: 25.32, 31.15).

The pooled prevalence of hypertension for those 11 studies, which collected data from both rural and urban areas, was 23.66% (95% CI: 18.59, 29.13). South Asian adults from urban areas show a higher prevalence of hypertension (36.91%, 95% CI: 29.21, 44.95) than rural adults (26.27%, 95% CI: 20.66, 32.31). In the case of the year of publication, the pooled prevalence of 5 studies from 2011-14 shows the highest prevalence of hypertension among adults of 37.79% (95% CI: 26.69, 49.58), whereas the pooled prevalence of 12 studies from 2019-23 shows the lowest prevalence of hypertension among adults of 25.26% (95% CI: 20.21, 30.67). All tests for heterogeneity trends are statistically significant (p<0.0001).

Parameters	Number of Studies pooled (with sample size)	Pooled prevalence of hypertension	I^2 (95% CI for I^2)	P for heterogeneity trend
COUNTRY				
Afghanistan	5 (n = 5829)	34.86% (29.11 to 40.85)	95.69% (92.45 to 97.54)	P < 0.0001
Bangladesh	5 (n = 42453)	24.29% (21.30 to 27.40)	98.10% (97.06 to 98.77)	P < 0.0001
Bhutan	1 (n = 31066)	17.41% (16.99 to 17.83)	-	-
India	11 (n = 220778)	30.71% (26.09 to 35.53)	99.53% (99.45 to 99.61)	P < 0.0001

Nepal	4 (n = 30742)	24.72% (16.61 to 33.85)	99.61% (99.48 to 99.71)	P < 0.0001
Pakistan	2 (n = 18025)	25.89% (10.99 to 44.46)	99.81% (99.72 to 99.87)	P < 0.0001
SEX				
Male	28 (n = 198376)	29.12% (24.91 to 33.51)	99.66% (99.63 to 99.69)	P < 0.0001
Female	28 (n = 150517)	28.18% (25.32 to 31.15)	99.26% (99.17 to 99.35)	P < 0.0001
HABITAT				
Rural	8 (n = 37002)	26.27% (20.66 to 32.31)	99.30% (99.11 to 99.45)	P < 0.0001
Urban	9 (n = 5348)	36.91% (29.21 to 44.95)	99.41% (99.27 to 99.52)	P < 0.0001
Rural and Urban	11 (n = 284324)	23.66% (18.59 to 29.13)	99.86% (99.85 to 99.88)	P < 0.0001
YEAR OF PUBLICATION				
2011-2014	5 (n = 24653)	37.79% (26.69 to 49.58)	99.63% (99.53 to 99.72)	P < 0.0001
2015-2018	11 (n = 45081)	28.01% (22.59 to 33.78)	99.38% (99.26 to 99.49)	P < 0.0001
2019-2023	12 (n = 279159)	25.26% (20.21 to 30.67)	99.84% (99.83 to 99.86)	P < 0.0001

Table 3: Summary of findings of studies reporting the prevalence of hypertension among South Asian adults.

Discussion

This systematic review and meta-analysis provide the prevalence and risk factors of hypertension among the South Asian population, holistically. Hypertension, one of the foremost modifiable risk factors for cardiovascular diseases (CVDs), is a great public health challenge on the global level, especially in emerging regions like South Asia.

Burden of hypertension in South Asia

The study brings out the fact that the prevalence of hypertension among South Asians is alarming, with a 'pooled prevalence' of 28.48%. This is a fact showing that there is a substantial burden in the region that can be attributed to the high prevalence of hypertension globally and consistent with the fact that there is a growing prevalence of hypertension in the LMICs [2]. The high hypertension prevalence in South Asia is a particularly major concern given its link to an enhanced likelihood of cardiovascular diseases (CVDs), such as ischemic heart diseases and stroke which are the main causes of morbidity and mortality in the world [5].

Regional disparities and variability

This systematic review and meta-analysis come up with huge differences in the prevalence of hypertension among South Asian countries, which is from 12.29% to 57.83%. It reveals that country-specific factors like genetic traits, lifestyle, dietary habits, and healthcare facilities should be considered during the study of the epidemiology of hypertension [8]. India illustrates both the highest and lowest rates of hypertension prevalence, meaning some other countries like Pakistan, Nepal and Afghanistan also show substantial differences in prevalence rates. These disparities at the regional level create a need for public health measures to adequately address hypertension.

Associated risk factors

This study determines several risk factors linked with hypertension among South Asian adults including age, residence in urban areas, illiteracy, diabetes, hypercholesterolemia, smoking, sedentary lifestyle, central obesity, and high BMI. These results,

like the previous findings, point to the multifactorial nature of hypertension and the complicated multi-pattern interactions of genetic, environmental, and lifestyle factors [24,30]. Such risk factors identified therefore offer precious information needed for designing prevention approaches to reduce the prevalence of hypertension and avoid its consequences.

Public health implications

The fact that South Asian adults have the highest prevalence of hypertension among all ethnic groups shows how critical it is to implement effective public health interventions that can tackle the growing load of health burden Interventions might be population-based campaigns that target health-enhancing behavior, which include; physical activity, balanced diet, smoking cessation and stress management [9]. Targeted screening programs are also one of the effective key points as well as affordable and effective antihypertensive medications and community-based interventions that raise awareness about hypertension and its risk factors are also necessary [4].

Future directions

Based on the above, prompt public health actions should be taken to cut the load of hypertension in South Asian adults. These interventions should be comprehensive and include multiple methods such as health promotion, early detection, lifestyle modifications, and the availability of affordable healthcare services. Culturally appropriate strategies developed to raise awareness concerning hypertension, promote healthy activities, and make regular blood pressure screenings available are important for better cardiovascular results in this community.

Conclusion

In conclusion, this systematic review and meta-analysis provide valuable data about the occurrence and factors of hypertension among South Asian adults. The study results reflect not only the critical role hypertension plays among the inhabitants of South Asia but also the obvious necessity for tailored interventions to overcome this significant public health problem. Given the multiple interacting risk factors leading to hypertension, physicians, policymakers, and public health researchers can use evidence-based approaches to prevent and control hypertension.

In the future, collaborative implementation of comprehensive interventions targeting the socioeconomic, cultural and environmental determinants of hypertension in the South Asian population is needed. Through a unified course of action involving community engagement, improvement of the health infrastructure, and policy support, we shall be laying the foundation to reducing the prevalence of hypertension and heart diseases in South Asia. Through emphasizing prevention and cardiovascular health education we can aim to achieve better health results while improving the overall quality of life of South Asian adults.

Limitations of the Study

Articles were searched from electronic databases, such as PubMed, PMC, Google Scholar, and Scopus. Other electronic databases and print databases, grey material, theses, and dissertations were not considered for the present systematic review and meta-analysis. The search period was limited to January 2011 to June 2023. The data search was conducted between August 3 and October 12, 2023. This systematic review is limited to the South Asian adult population only. Only articles published in the English language were included for analysis. Acknowledgment

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Bibliography

1. Schutte AE., *et al*. "Hypertension in Low- and Middle-Income Countries". *Circulation Research* 128.7 (2021): 808-826.

2. Mohsen Ibrahim M. "Hypertension in Developing Countries: A Major Challenge for the Future". *Current Hypertension Reports* 20.5 (2018): 38.

3. Damor AK., *et al*. "Prevalence and associated risk factors of hypertension among adults in Rajasthan, India". *European Journal of Molecular and Clinical Medicine* 9.6 (2022): 1823-1828.

4. Cao Y., *et al*. "Factors Associated With Hypertension Awareness, Treatment, and Control Among Adults in Kerala, India". *Frontiers in Public Health*, 9 (2021): 753070.

5. Roth G A., *et al*. "Global Burden of Cardiovascular Diseases and Risk Factors, 1990-2019: Update from the GBD 2019 Study". *Journal of the American College of Cardiology 76*.25 (2020): 2982-3021.

6. World Heart Report. "Confronting the World's Number One Killer". Geneva, Switzerland. World Heart Federation (2023).

7. Midha T., *et al*. "Prevalence of isolated diastolic hypertension and associated risk factors among adults in Kanpur, India". *Indian Heart Journal 64*.4 (2012): 374-379.

8. Geevar Z., *et al*. "Prevalence, Awareness, Treartment, and Control of Hypertension in Young Adults (20-39 Years) in Kerala, South India". *Frontiers in Cardiovascular Medicine* 9 (2022): 765442.

9. Thrift AG., *et al*. "Hypertension in Rural India: The Contribution of Socioeconomic Position". *Journal of the American Heart Association 9*.7 (2020): e014486.

10. Bharti N and Ranjan R. "Prevalence of Hypertension Among Adults - A Cross Sectional Study". *International Journal of Health and Clinical Research* 3.12S (2020): 71-74.

11. Godara R., *et al*. "Prevalence, awareness, treatment and control of hypertension among adults aged 30 years and above in Barmer district, Rajasthan, India". *Indian Heart Journal* 73.2 (2021): 236-238.

12. Rannan-Eliya RP., *et al*. "Prevalence and Associations of Hypertension in Sri Lankan Adults: Estimates from the SLHAS 2018-19 Survey Using JNC7 and ACC/AHA 2017 Guidelines". *Global Heart* 17.1 (2022): 50.

13. Rahman M., *et al*. "Prevalence, treatment patterns, and risk factors of hypertension and pre-hypertension among Bangladeshi adults". *Journal of Human Hypertension 32*.5 (2018): 334-348.

14. Huang Y., *et al*. "Prevalence of hypertension and prehypertension in Nepal: a systematic review and meta-analysis". *Global Health Research and Policy 4* (2019): 11.

15. Akram M., *et al*. "Prevalence of Hypertension and Associated Co-Morbidities in Pakistan". *Mathews Journal of Nursing* 5.1 (2023): 11.

16. Wangdi K and Jamtsho T. "Prevalence and predisposing factors for self-reported hypertension in Bhutanese adults". *Nepal Journal of epidemiology 10*.1 (2020): 830-840.

17. Page M J., *et al*. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews". *BMJ* 372 (2021): 71.

18. Chobanian A V., *et al*. "The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report". *JAMA* 289.19 (2003): 2560-2572.

19. Field AP and Gillett R. "How to do a meta-analysis". *British Journal of Mathematical and Statistical Psychology* 63.3 (2010): 665-694.

20. Higgins J P., *et al*. "Measuring inconsistency in meta-analyses". *BMJ* 327.7414 (2003): 557-560.

21. Ferguson C J., *et al*. "Publication bias in psychological science: prevalence, methods for identifying and controlling, and implications for the use of meta-analyses". *Psychology Methods* 17.1 (2012): 120-128.

22. Saeed KM I., *et al*. "Prevalence and predictors of adult hypertension in Kabul, Afghanistan". *BMC Public Health 14* (2014): 386.

23. Saeed K M I. "Prevalence of hypertension and associated factors in Jalalabad City, Nangarhar Province, Afghanistan". *Central Asian Journal of Global Health 4*.1 (2015): 134.

24. Saeed K M. "Burden of Hypertension in the Capital of Afghanistan: A Cross-Sectional Study in Kabul City, 2015". *International Journal of hypertension* (2017): 3483872.

25. Saeed K M I. "Prevalence and Associated Factors of High Blood Pressure in Urban Setting of Kandahar City in Afghanistan in 2015". *Jundishapur Journal of Health Science* 9.3 (2017): e59990.

26. Saeed K M I. "Prevalence and Associated Factors of Hypertension in Hirat City Afghanistan, 2015". *IOSR Journal of Pharmacy* 7.1 (2017): 42-50.

27. Chowdhury M A., *et al*. "Hypertension among adults in Bangladesh: evidence from a national cross-sectional survey". *BMC Cardiovascular Disorders 16* (2016): 22.

28. Khanam R., *et al*. "Prevalence and factors associated with hypertension among adults in rural Sylhet district of Bangladesh: a cross-sectional study". *BMJ Open 9*.10 (2019): e026722.

29. Simmons SS., *et al*. "The Influence of Anthropometric Indices and Intermediary Determinants of Hypertension in Bangladesh". *International Journal of Environmental Research and Public Health 18*.11 (2021): 5646.

30. Khan MN., *et al*. "Prevalence, awareness, treatment, and control of hypertension in Bangladesh: Findings from National Demographic and Health Survey, 2017-2018". *Journal of Clinical Hypertension (Greenwich, Conn.) 23*.10 (2021): 1830-1842.

31. Das S., *et al*. "Association of overweight and obesity with hypertension, diabetes and comorbidity among adults in Bangladesh: evidence from nationwide Demographic and Health Survey 2017-2018 data". *BMJ Open 12*.7 (2022): e052822.

32. Gupta R., *et al*. "Normotension, prehypertension, and hypertension in urban middle-class subjects in India: prevalence, awareness, treatment, and control". *American Journal of Hypertension 26*.1 (2013): 83-94.

33. Rani R., *et al*. "Prevalence study of hypertension among adults in an urban area of Jammu". *Journal of Scientific and Innovative Researc*h 3.2 (2014): 143-147.

34. Banerjee S., *et al*. "Prevalence, awareness, and control of hypertension in the slums of Kolkata". *Indian Heart Journal 68*.3 (2016): 286-294.

35. Zafar K S., *et al*. "The prevalence of hypertension among young adults in a rural population of North India". *International Journal of Research in Medical Sciences 5*.11 (2017): 4869-4872.

36. Ramakrishnan S., *et al*. "Prevalence of hypertension among Indian adults: Results from the great India blood pressure survey". *Indian Heart Journal 71*.4 (2019): 309-313.

37. Ganie M A., *et al*. "Prevalence, pattern & correlates of hypertension among tribal population of Kashmir, India: A cross-sectional study". *The Indian Journal of Medical Research 154*.3 (2021): 467-475.

38. Datta PS. "Association between Body Mass Index and Blood Pressure Among Rural Indian Adults". *Acta Scientific Medical Sciences* 5.3 (2021): 20-24.

39. Vinay KA., *et al*. "Prevalence of Hypertension in the Rural Community of Central Maharashtra, India". *International Journal of Medicine and Public Health* 22 (2012): 39-45.

40. Sharma S K., *et al*. "Prevalence of hypertension, obesity, diabetes, and metabolic syndrome in Nepal". *International Journal of hypertension* (2011): 821971.

41. Koju R., *et al*. "Undertreated Hypertension and its Implications for Public Health in Nepal: Nationwide Population-Based Survey". *Kathmandu University Medical Journal (KUMJ) 13*.49 (2015): 3-7.

42. Sainju N K., *et al*. "Screening for Hypertension and Obesity in Rural Population of Nepal". *Kathmandu University Medical Journal (KUMJ) 16*.61 (2018): 4-7.

43. Gupta R D., *et al*. "Prevalence and Associated Factors of Hypertension Subtypes Among the Adult Population in Nepal: Evidence from Demographic and Health Survey Data". *Osong Public Health and Research Perspectives 10*.6 (2019): 327-336.

44. Safdar N F., *et al*. "Dietary patterns and their association with hypertension among Pakistani urban adults". *Asia Pacific Journal of Clinical Nutrition 24*.4 (2015): 710-719.

45. Shafi S T and Shafi T. "A survey of hypertension prevalence, awareness, treatment, and control in health screening camps of rural central Punjab, Pakistan". *Journal of Epidemiology and Global Health 7*.2 (2017): 135-140.