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Review Article

Prevalence, awareness, risk factors and control of hypertension in Nepal from 2000 to 2020: A systematic review and meta-analysis

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ABSTRACT

Objective: To analyse published literatures on prevalence, awareness, risk factors and control of hypertension in Nepal.

Methods: We used electronic databases to search relevant articles from January 2000 till October 2020. All relevant data from selected studies were extracted into a standardized form designed in Excel. Statistical analysis was conducted using Comprehensive Meta-Analysis Software (CMA) version 3. Proportions or Odds Ratio (OR) was used to estimate the outcome with 95% confidence interval (CI). The I-squared (I^2) test was used for the assessment of heterogeneity.

Results: We identified a total of 3726 studies after comprehensive database searching. We performed qualitative and quantitative analysis of 40 studies. Pooling data showed 28.52% of patients with hypertension (CI: 26.40–30.75); 45.28% (CI: 38.89–51.83) aware of their high blood pressure; 31.66% (CI: 23.18–41.56) under treatment; 44.4% (CI: 36.17–53.04) had their blood pressure under optimum range. 27.4% (CI: 21.57–34.11) had pre-hypertensive range elevated blood pressure. 25.99% (CI: 21.81–30.65) of females and 34.25% (CI: 30.49–38.21) of male were hypertensive ($p = 0.007$).

The pooling of data showed smokers have 1.43 times (CI: 1.1429–1.7889); and alcohol users have 2.073 times (CI: 1.7154–2.5050) higher risk of having hypertension. Individuals with normal BMI have 53.15% (OR: 0.4685 CI: 0.3543–0.6195); with formal educated have 37.27% (OR: 0.6273, CI: 0.5485–0.7175); and with adequate exercise have 31.6% (OR: 0.6839, CI: 0.5203–0.8991) lower chance of having hypertension.

Conclusion: Our study shows the prevalence of hypertension in Nepal is high. However, awareness, treatment and subsequently control of high blood pressure are found to be alarmingly low. Hypertension was associated with male gender, smoking, alcohol use, high BMI, no education and inadequate exercise. It calls for more attention to address the burden of hypertension and associated risk factors in Nepal.

1. Introduction

Hypertension (HTN), which is also known as High Blood Pressure (HBP) is one of the leading preventable risk factors for premature cardiovascular diseases and mortality [1]. Persistent uncontrolled hypertension can cause complications like stroke, heart failure, atrial fibrillation, kidney failure, coronary artery diseases, peripheral vascular diseases, retinopathies and vascular dementia [2–4]. Factors such as

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unhealthy diet (especially high salt consumption), alcohol and tobacco use, increasing trends of sedentary lifestyle and ageing are attributed to the development of hypertension [5,6].

Hypertension has become one of the major challenging public health concerns globally. It was estimated that more than one billion adults were living with it in 2015, most of them belonging to low and middle income countries [6–8]. Globally, hypertension has reportedly been responsible for 12.8% of all total annual deaths and 3.7% of total disability-adjusted life years (DALYs) [9]. Throughout the world, the high prevalence of hypertension has significantly contributed to present cardiovascular disease pandemic and it is estimated that 29% (i.e. 1.56 billion) of the world's adult population will be having hypertension by 2025 [6]. The prevalence, awareness and risk factors of hypertension in Nepal has not been properly studied. As much of our health system is focused on battling against communicable diseases like tuberculosis, malaria, kala-azar and other tropical diseases, there is a lack of focus towards common non-communicable diseases which account for a bulk of health problems. Thus, we aimed to evaluate the prevalence, awareness, risk factor and control of hypertension in Nepal through our meta-analysis.

2. Objectives

This study was aimed to determine the prevalence of hypertension in Nepal in last 20 years. Additionally, this study carried out to explore awareness, treatment status and control of blood pressure to optimum among those under treatment. Further, we assessed the risk factors related to hypertension in context to Nepal.

3. Methods

3.1. Protocol registration

The systematic review was registered in PROSPERO (CRD 42020212230) and was documented according to the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines [10].

3.2. Data sources and search strategy

We used electronic databases like Pubmed, Pubmed Central, Scopus and Google scholar to search relevant articles from January 2000 till October 2020 using the following MeSH terms and appropriate Boolean operators as: "hypertension" [MeSH] OR "high blood pressure" [Tiab] OR "Hypertension" AND ("prevalence" OR "risk factor") AND "Nepal" AND PUB YEAR >1999. The detailed search strategy is documented as Supplementary Appendix 1.

3.3. Eligibility criteria

The eligibility criteria for inclusion were: (1) Cross-sectional studies, prospective and retrospective cohort studies from January 2000 till October 2020; (2) Studies reporting prevalence, awareness, control or risk factors of hypertension in adults (18 years and above) living in Nepal; (3) Published articles. We excluded (1) studies involving older adults who were attending hospital or were hospitalized for chronic diseases; (2) Studies with outcomes like self-reported hypertension; (3) Case reports, case series, narrative reviews, letter to editors, abstracts and posters. For studies with the same dataset, we considered the most comprehensive and updated one.

3.4. Study selection

We filtered the studies using COVIDENCE. Two reviewers (SL, AB) independently screened the title and abstract based on the inclusion criteria. Discrepancies were resolved by consensus obtained from the third reviewer (MS).

3.5. Data collection process and data items/data extraction

All the data were extracted independently by four reviewers (PB, AB, MS, and SL) into a standardized form designed in Excel. All reviewers were involved in verifying the accuracy and completeness of other's work. The characteristics extracted for each selected study include: first author, year of publication, age group of participants, prevalence of hypertension and prehypertension, population under antihypertensive medication, level of awareness, those with controlled blood pressure and associated risk factors.

3.6. Summary measures

Hypertension was defined as systolic blood pressure (SBP) of 140 mm Hg or more, and/or diastolic blood pressure (DBP) of 90 mm Hg or more, or taking antihypertensive medication (JNC VII). Prehypertension was defined as SBP of 120–139 mm Hg and/or DBP of 80–89 mm Hg. Hypertension control was defined as a hypertensive patient with SBP <140 mm Hg and DBP <90 mm Hg on antihypertensive medication [11].

3.7. Data synthesis

Statistical analysis was conducted using Comprehensive Meta-Analysis Software (CMA) version 3. Proportions or Odds Ratio (OR) was used to estimate the outcome with 95% confidence interval (CI). The I-squared (I^2) test was used for the assessment of heterogeneity (0%–40%- might not be important; 30% to 60%- may represent moderate heterogeneity; 50% to 90%- may represent substantial heterogeneity; 75% to 100%- considerable heterogeneity) [12]. Heterogeneity between studies was evaluated using a fixed/random-effects model. Forest plot was used to visualize the degree of variation between studies.

3.8. Risk of bias assessment based on the critical appraisal checklist

We performed the qualitative assessment of the individual study using the Joanna Briggs Institute (JBI) critical appraisal tool. This checklist consisted of 9-items that assessed the methodological quality of a study and determined the extent to which a study has addressed the possibility of bias in its design, conduct and analysis [13]. The bias assessment of 40 included studies are depicted in Table 1.

3.9. Subgroup analysis

Subgroup analyses were conducted based on gender.

3.10. Sensitivity analysis

Sensitivity analysis for prevalence of hypertension carried out by excluding studies with participants less than 500. For other outcomes, sensitivity analysis was done excluding individual study to evaluate its effect in the overall result.

4. Results

We identified a total of 3726 studies after comprehensive database searching. After removal of 365 duplicates, we screened the title and abstracts of 3361 studies. We excluded 3219 studies and assessed the full-text eligibility of 142 studies. A total of 102 studies were excluded with definite reasons and we performed qualitative analysis of 40 studies. Similarly, quantitative analysis of 40 studies were done (Fig. 1).

4.1. Qualitative analysis

The qualitative analysis of 40 included studies are depicted in Table 2. The detailed results of the qualitative synthesis are provided as Supplementary Appendix 2.

Table 1
Bias assessment.

JBI CHECKLIST(ROW) Study(COLUMN)	Was the sample frame appropriate to address the target population?	Were study participants sampled in an appropriate way?	Was the sample size adequate?	Were the study subjects and the setting described in detail?	Was the data analysis conducted with sufficient coverage of the identified sample?	Were valid methods used for the identification of the condition?	Was the condition measured in a standard, reliable way for all participants?	Was there appropriate statistical analysis?	Was the response rate adequate, and if Not, was the low response rate managed appropriately?	Overall Apprasial
Karki [14], 2019	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Manandhar [15], 2012	YES	YES	YES	NO	NO	YES	YES	YES	YES	INCLUDE
Kafle [16], 2018	YES	YES	YES	NO	NO	YES	YES	NO	YES	INCLUDE
Maharjan [17], 2017	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Khanal [18], 2018	NO	NO	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Chataut [19], 2011	YES	YES	YES	YES	NO	YES	YES	YES	YES	INCLUDE
Khanal [20], 2019	YES	NO	YES	NO	NO	YES	YES	YES	YES	INCLUDE
Dhungana [21], 2018	YES	YES	YES	YES	NO	YES	YES	YES	YES	INCLUDE
Dhungana [22], 2014	YES	YES	YES	YES	YES	YES	YES	UNCLEAR	YES	INCLUDE
Shrestha S [23], 2016	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
TANDSTAD [24], 2017	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Shrestha D [25], 2016	YES	YES	YES	YES	YES	YES	YES	NO	YES	INCLUDE
Lamsal [26], 2012	YES	NO	NO	YES	YES	YES	YES	NO	YES	INCLUDE
Mishra [27], 2019	YES	YES	YES	YES	YES	YES	UNCLEAR	UNCLEAR	YES	INCLUDE
Adhikari [28], 2020	YES	YES	YES	YES	YES	YES	UNCLEAR	UNCLEAR	YES	INCLUDE
Vaidya [29], 2012a	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Ghimire [30], 2018	NO	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Anil [31], 2018	NO	NO	UNCLEAR	YES	YES	YES	YES	YES	YES	INCLUDE
Chataut [32], 2015	YES	YES	YES	YES	YES	YES	YES	UNCLEAR	UNCLEAR	INCLUDE
Dhungana [33], 2016	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Shrestha [34], 2006	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Vaidya [35], 2007	NO	YES	YES	YES	YES	YES	UNCLEAR	YES	UNCLEAR	INCLUDE
Koju [36], 2010	YES	YES	YES	YES	YES	YES	UNCLEAR	NO	UNCLEAR	INCLUDE
Sharma [37], 2011	YES	UNCLEAR	YES	YES	YES	YES	YES	YES	UNCLEAR	INCLUDE
Karla [38], 2011	YES	YES	NO	YES	YES	YES	NO	NO	UNCLEAR	INCLUDE
Vaidya [39], 2012b	YES	UNCLEAR	YES	YES	YES	YES	UNCLEAR	YES	YES	INCLUDE
Koju [40], 2015	YES	YES	YES	YES	YES	YES	UNCLEAR	YES	YES	INCLUDE
Khanal [41], 2017	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Sainju [42], 2018	YES	YES	YES	YES	YES	YES	UNCLEAR	YES	YES	INCLUDE
Gyawali [43], 2019	YES	UNCLEAR	YES	YES	YES	YES	UNCLEAR	YES	UNCLEAR	INCLUDE
Gupta [44], 2019	YES	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Neupane [45], 2017	YES	YES	YES	NO	YES	YES	YES	YES	YES	INCLUDE
Karmacharya [46], 2017	NO	UNCLEAR	NO	YES	YES	YES	YES	YES	UNCLEAR	INCLUDE
Devkota [47], 2016	YES	YES	NO	YES	YES	YES	YES	YES	UNCLEAR	INCLUDE
Aryal [48], 2018	NO	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Vaidya [49], 2013	NO	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Pyakurel [50], 2018	NO	YES	YES	NO	YES	YES	YES	NO	YES	INCLUDE
Sharma [51], 2013	YES	NO	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Vaidya [52], 2014	NO	YES	YES	YES	YES	YES	YES	YES	YES	INCLUDE
Mehta [53], 2011	YES	UNCLEAR	YES	YES	YES	YES	YES	YES	YES	INCLUDE

4.2. Quantitative analysis

Total 40 studies were included in quantitative synthesis.

4.2.1. Prevalence of hypertension

Using random effect model pooling data from 40 studies showed 28.52% patient with hypertension (Proportion: 0.2852; CI:

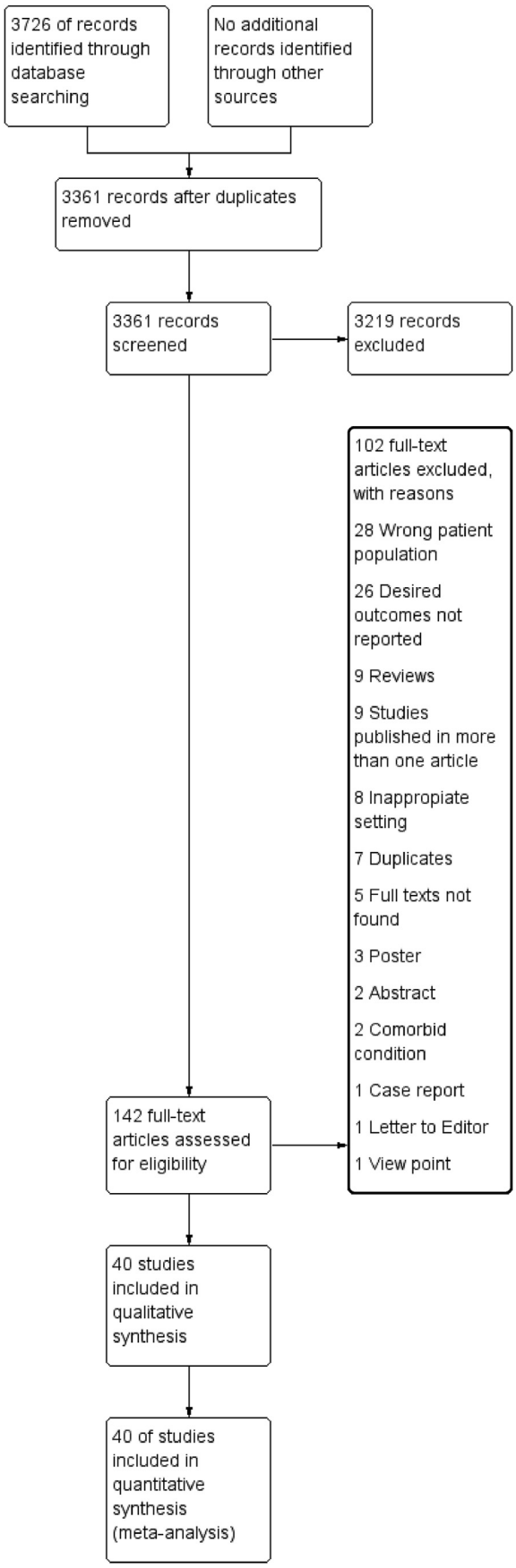

Fig. 1. Prisma flow diagram.

0.2640–0.3075; I^2: 97.73) (Fig. 2). Sensitivity analysis done excluding individual studies and studies with sample size of less than 500; showed no significant changes (Supplementary Appendix 3; Figs. 1 and 2). Further analysis for prevalence of hypertension based on the timeframe and re-running analysis using random effect showed 26.92% hypertension between 2011 and 2015 (Proportion, 0.2692; CI, 0.2277–0.3152). Similarly, prevalence of hypertension was 31% for 2016–2020 (Proportion, 0.3100; CI, 0.2797–0.3421) (Supplementary Appendix 3; Figs. 3 and 4).

4.2.2. *Awareness of hypertensive status*

Total 12 studies showed hypertensive awareness status, pooling of data among those studies using random-effect model showed 45.28% of hypertensive patients only aware of the fact that they have high blood pressure (Proportion: 0.4528; CI: 0.3889–0.5183; I^2: 95.27%) (Fig. 3). Sensitivity analysis excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 5).

4.2.3. *Hypertensive individuals under treatment*

Seventeen studies reported treatment status among hypertensive patients. Among hypertensive individuals 31.66% were under some form of treatment for their hypertension (Proportion: 0.3166; CI: 0.2318–0.4156; I^2: 99.09%) (Fig. 4). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 6).

4.2.4. *BP under control among patient under treatment*

Twelve studies reported blood pressure status among hypertensive patients receiving their treatment. Among hypertensive individuals under some form of treatment, 44.4% have their blood pressure under optimum range (Proportion: 0.4444; CI: 0.3617–0.5304; I^2: 94.8) (Fig. 5). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 7).

4.2.5. *Prevalence of pre-hypertension*

Fourteen studies reported prevalence of pre-hypertension in their study population. Pooling data from all 14 studies showed 27.4% have pre-hypertensive range elevation in blood pressure (Proportion: 0.2740; CI: 0.2157–0.3411; I^2: 98.65) (Fig. 6). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 8).

4.2.6. *Prevalence of hypertension based on gender*

Twenty-six studies segregated the prevalence of hypertension among females and 27 studies among male. Pooling of data showed 25.99% of females were hypertensive (Proportion: 0.2599; CI: 0.2181–0.3065; I^2: 98.59) while 34.25% of male were hypertensive (Proportion: 0.3425; CI: 0.3049–0.3821; I^2: 97.21%) and difference was significant ($p = 0.007$) (Supplementary Appendix 3; Fig. 9).

4.2.7. *Smoking and hypertension*

Thirteen studies reported smoking status among hypertensive individuals. The pooling of data using random-effect model showed smokers have 1.43 times higher odds of having hypertension comparing with non-smokers (OR: 1.4299, CI: 1.1429–1.7889; I^2: 75.82) (Fig. 7). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 10).

4.2.8. *Alcohol use and hypertension*

Twelve studies reported alcohol use habits among hypertensive individuals. The pooling of data using random-effect model showed alcohol users have 2.073 times higher odds of having hypertension comparing with alcohol non-users (OR: 2.0729; CI: 1.7154–2.5050; I^2: 63.56) (Fig. 8). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 11).

Table 2
Qualitative table.

Study	Study type	Study Location	Study date	Sample size	Age group	Response Rate	BP Instrumentation	Measurement frequency	Total number of hypertension cases	Total number of pre-hypertension cases
Karki [14], 2019	Community based observational cross-sectional study	Ribdikot Rural Municipality and Tansen Municipality of Palpa district	May to July 2019.	372	20 and above	–	Manual Doctor's aneroid Sphygmomanometer and stethoscope	3	82/372 (22%)	–
Manandhar [15], 2012	Population based cross- sectional study,	11 wards of Banepa municipally, wards number 1, 3, 5, 6, 7, and 10	May 15 to June 15, 2009	405	Above 50 population	–	Manual Doctor's aneroid Sphygmomanometer and stethoscope	2	182/405 (44.9%)	–
Kafle [16], 2018	Community-based cross-sectional survey	ward number eight of Suklagandaki municipality of Tanahu district	1st November - December 30, 2017	568	Above 18	–	Calibrated aneroid sphygmomanometer and stethoscope	2	236/568 (41.5%)	–
Maharjan [17], 2017	Community cross sectional study	4 wards (wards not specified) Kirtipur Municipality	December 2015 to April 2016	580	Age between 20 and 59 years	–	Manual Doctor's aneroid Sphygmomanometer and stethoscope	1	215/580 (37%)	130/580 (22.4%)
Khanal [18], 2018	Community-based cross-sectional survey	Lamjung district-2014	October–November 2014	388	40–80 years of age	88.9%	Manual Doctor's aneroid Sphygmomanometer and stethoscope	3	182/345 (52.9%)	–
Chataut [19], 2011	Cross sectional study	Dhulikhel district	Janawary to march 2011	527	age ≥18 years	–	Manual mercury sphygmomanometer and stethoscope	2	118/527 (22.4%)	253/527 (48%)
Khanal [20], 2019	Descriptive cross-sectional study	Deurali Village of Nuwakot district	May to July 2019.	234	age ≥18 years	–	Aneroid sphygmomanometer and stethoscope	1	20/234 (8.54%)	–
Dhungana [21], 2018	Cross sectional study	Sitapaila Village Development Committee, Kathmandu	February 2014 to February 2015.	347	18–70years	–	Doctor's Aneroid Sphygmomanometer and stethoscope	3	120/347 (34.6%)	–
Dhungana [22], 2014	Cross sectional study	Tinkanya Village Development Committee, Sindhuli	January and April 2014	406	age 20–50 years	–	Doctor's Aneroid Sphygmomanometer and stethoscope	3	49/406 (12.3%)	13/406 (3.2%)
Shrestha S [23], 2016	Cross sectional study	Changunarayan Municipality	April and May 2015	240	aged ≥18	–	Adult size aneroid sphygmomanometer and stethoscope	3	49/240 (20.4%)	85/240 (35.4%)
TANDSTAD [24], 2017	Hospital based Cross sectional study	Kirnetar health Center, Dolakha, Nepal	Oct to Nov 2016	260	≥18 years	–	Fully automated BP monitor	2	50/260 (19.2%)	–
Shrestha D [25], 2016	Cross sectional study	Hansposa VDC, Sunsari, Nepal	Sep 25 to oct 25 2014	351	≥25 years	–	Aneroid sphygmomanometer	3	130/351 (37%)	42/351 (11.97%)
Lamsal [26], 2012	Cross sectional study	High hilly areas of ramechhap, solukhumbu and dolakha district	21–25 oct 2009	600	≥18 years	–	Standard Riva Rocci Sphygnomanometer	2	214/600 (35.6%)	92/600 (15.33%)
Mishra [27], 2019	Cross sectional study	Total 18 sites in 7 districts covering 5 provinces (excluding province 2 and 6)	May and June 2017	5968	≥18 years	–	Both digital (OMRON) and manual sphygmomanometers	3	1456/5968 (24.4%)	–
Adhikari [28], 2020	Cross sectional study	35 districts of Nepal	May 2018	15561	≥18 years	–	Both digital (OMRON) and manual sphygmomanometers	3	4321/15561 (27.8%)	–
Vaidya [29], 2012a	Population-based cross sectional study	Duwakot village of Bhaktapur District	Nov 2009	641	≥35 years	–	Standard mercury sphygmomanometer	2	112/641 (17.5%)	–
		Nepal	2013	526	60–69 years	–		–	292/526 (57.2%)	–

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Table 2 (*continued*)

Study	Study type	Study Location	Study date	Sample size	Age group	Response Rate	BP Instrumentation	Measurement frequency	Total number of hypertension cases	Total number of pre-hypertension cases
Ghimire [30], 2018	Secondary analysis of STEPS survey 2013						Automated digital blood pressure monitor			
Anil [31], 2018	Cross sectional study	Kathmandu valley	2014	5530	≥18 years	–	Standardized calibrated mercury column type sphygmomanometer	4	1460/5530 (26.4%)	2605/5530 (47.1%)
Chataut [32], 2015	Community based cross-sectional study	Rural community of Ramechap district	NR	648	≥18 years	–	Standard mercury sphygmomanometer	–	133/648 (20.5%)	302/648 (46.6%)
Dhungana [33], 2016	Community based cross-sectional study	Kathmandu	Jan–July 2015	587	≥18 years	–	Aneroid sphygmomanometer	3	191/587 (32.5%)	–
Shrestha [34], 2006	Cross sectional study	Seven urban municipalities	2001 to 2002	1012	≥40	85.7%	Mercury sphygmomanometer	2	230/1012 (22.7%)	–
Vaidya [35], 2007	Cross sectional study	Dharan Municipality	Jun 2004 to Feb 2005	1000	≥35	–	Mercury sphygmomanometer	2	227/1000 (22.7%)	–
Koju [36], 2010	Cross sectional study	Dhulikhel municipality	2007	796	18-88 (48.41 ± 17.38)	–	Mercury sphygmomanometer	2	230/796 (28.9%)	42/230 (18.3)
Sharma [37], 2011	Cross sectional study	Eastern region	2007	14422	20-100 (41.4 ± 15.1)	–	Mercury sphygmomanometer	1	4894/14422 (33.9%)	–
Karla [38], 2011	Cross sectional study	Dharan Municipality	NR	119	35-86 (54.1 ± 10.5)	–	NR	NR	42/119 (35.3%)	–
Vaidya [39], 2012b	Cross sectional study	Bhadrabas village area of Kathmandu valley	2006	1218	≥21 (40.54 ± 16)	84%	Mercury sphygmomanometer	NR	412/1218 (33.8%)	–
Koju [40], 2015	Cross sectional study	Nationwide	May-13	2100	18-65 (34.4 ± 12.8)	99.6%	Digital	2	317/2100 (15.1%)	915/2100 (43.6%)
Khanal [41], 2017	Cross sectional study	Birendranagar Municipality of Surkhet District	Jan to Dec 2016	1159	≥30 (47 ± 12.6)	–	Aneroid sphygmomanometer	2	451/1159 (38.9%)	–
Sainju [42], 2018	Cross sectional study	Sindupalchowk District	2016	1243	≥18 (48.73 ± 16.25)	–	Mercury sphygmomanometer	1	375/1243 (30.17%)	137/1243 (11.02%)
Gyawali [43], 2019	Cross sectional study	Pokhara Metropolitan City	2016	2310	25–64	–	Digital	2	797/2310 (34.5%)	–
Gupta [44], 2019	Secondary analysis of NDHS Survey	Entire Nepal	June 2016 to January 2017	13393	Above or equal to 18	–	A & D Medical BP Monitor	3	2827/ 13393(21.1%, 95% CI = 19.9% - 22.4%)	–
Neupane [45], 2017	Cross- sectional survey	Lekhnath Municipality, Western Nepal	2013	2815	25–65 year old	80%	Digital Sphygmomanometer	3	28% (95% CI = 26–30%)	–
Karmacharya [46], 2017	Cross-sectional study	Dhulikhel	November 2013–February 2015	1073	Above 18	–	Standard Digital Blood Pressure Machine	3	298/1073 (27.78%)	–
Devkota [47], 2016	Community cross sectional study	Municipalities of Kathmandu District	January–July 2015	587	18–70 years	–	Aneroid Sphygmomanometer and stethoscope	3	191/587 (32.5%)	–
Aryal [48], 2018	Cross-sectional survey of high altitude	More than 2800 m from sea level in Mustang and Humla	June 2014–August 2014 March 2015–May 2015	521	More than 30 years	90%	Automatic blood pressure measuring device	3	181/521 (34.74%)	159/521 (30.52%)
Vaidya [49], 2013	Community based cross-sectional study	Bhaktapur district of Kathmandu Valley	September to November 2011	777	25–59 years	94.07%	Automated measurement	3	168/777 (21%)	–
Pyakurel [50], 2018	Cross-sectional study	Eastern Nepal Sunsari and Morang	July 2012 to July 2013	494	20–59 years	–	Standard technique	2	166/494 (33.60%)	205/494 (41.5%)

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Table 2 (*continued*)

Study	Study type	Study Location	Study date	Sample size	Age group	Response Rate	BP Instrumentation	Measurement frequency	Total number of hypertension cases	Total number of pre-hypertension cases
Sharma [51], 2013	Community based survey	Dharan	2003–2005	3218	More than 20 years	–	–	–	1243/3218 (38.6%)	–
Vaidya [52], 2014	Population based cross-sectional analytical study	Dharan Municipality	2004–2005	1000	Above 35 years old	–	Standard mercury sphygmomanometer	2	227/1000 (22.7%)	–
Mehta [53], 2011	Cross-sectional study	Sunsari District, Eastern Nepal	September 2005–July 2006	1270	Above 30 years	92.7% and 95% In rural and urban respectively	Standard adult mercury sphygmomanometer	1	615/1935 (31%)	752/1935 (38.86%)

4.2.9. BMI and hypertension

Twelve studies reported BMI among hypertensive individuals. The pooling of data using random-effect model showed having normal BMI has 53.15% lower odds of having hypertension (OR: 0.4685; CI: 0.3543–0.6195; $I^2 = 91.57$) (Fig. 9). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 12).

4.2.10. Education and hypertension

Twelve studies reported education status among hypertensive individuals. The pooling of data using random-effect model showed formal education has 37.27% lower odds of having hypertension (OR: 0.6273; CI: 0.5485–0.7175; $I^2 = 67.25$) (Fig. 10). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 13).

4.2.11. Exercise and hypertension

Eight studies reported exercise among hypertensive individuals. The pooling of data using random-effect model showed adequate exercise has 31.61% lower odds of having hypertension (OR: 0.6839; CI: 0.5203–0.8991; $I^2 = 83.82$) (Fig. 11). Sensitivity analysis performed excluding individual studies showed no significant differences (Supplementary Appendix 3; Fig. 14).

4.2.12. Diet, stress, salt intake, residential set-up and hypertension

The pooling of data using random-effect model showed no differences among diet type and hypertension (OR: 0.7568; CI: 0.4022–1.4238; $I^2 = 71.16$) (Supplementary Appendix 3; Fig. 15 and 16). The pooling of data using random-effect model did not show a statistically significant association of stress with and hypertension (OR: 2.6887; CI: 0.6840–10.5688; $I^2 = 93.21$) (Supplementary Appendix 3; Fig. 17 and 18). The pooling of data using random-effect model did not show a statistically significant association of salt intake and hypertension (OR: 1.200; CI: 0.7581–1.8997; $I^2 = 61.19$) (Supplementary Appendix 3; Fig. 19). The pooling of data using random-effect model did not show a statistically significant association of residential setup and hypertension (OR: 0.8891; CI: 0.7235–1.0927; $I^2 = 62.78$) (Supplementary Appendix 3; Fig. 20). Pooling of data on diet, stress, salt intake and residential set-up did not show significant relation with hypertension in this analysis. This may be because of less number of studies reporting these outcomes.

5. Discussion

We analyzed 40 studies done in different parts of Nepal after thorough database searching. We found out that hypertension and pre-hypertension are major health problems in Nepal with a prevalence of 28.52% and 27.5% respectively. The results are alarming because 56.02% have a different spectrum of hypertension disorders. The prevalence of pre-hypertension in our study was lower than that reported by Huang et al. (35.4%) which analyzed studies from 2000 to 2018, however, the prevalence of hypertension appears to be similar [54]. The prevalence of hypertension and pre-hypertension in Nepal was similar to the overall prevalence among SAARC countries as reported by Neupane et al. [55] Nepal has the third-highest prevalence of hypertension among the SAARC countries behind Maldives (31.5%) and India (31.4%) [55]. However, the prevalence of hypertension was lower than the global prevalence of hypertension which stands at 40.8% [56].

Only 45.23% of patients with hypertension were aware that they have hypertension. This is lower than the overall awareness in South Asia and Africa where 64.9% and 50.6% were aware that they had hypertension on the diagnosis [56]. Only 31.66% were under some form of antihypertensive following their diagnosis which was lower than 57.8% in South Asia and 46.6% in Africa [56]. This may be attributed to lack of affordability, poor patient counseling regarding the necessity of adhering to treatment, inaccessible health services and increased costs during

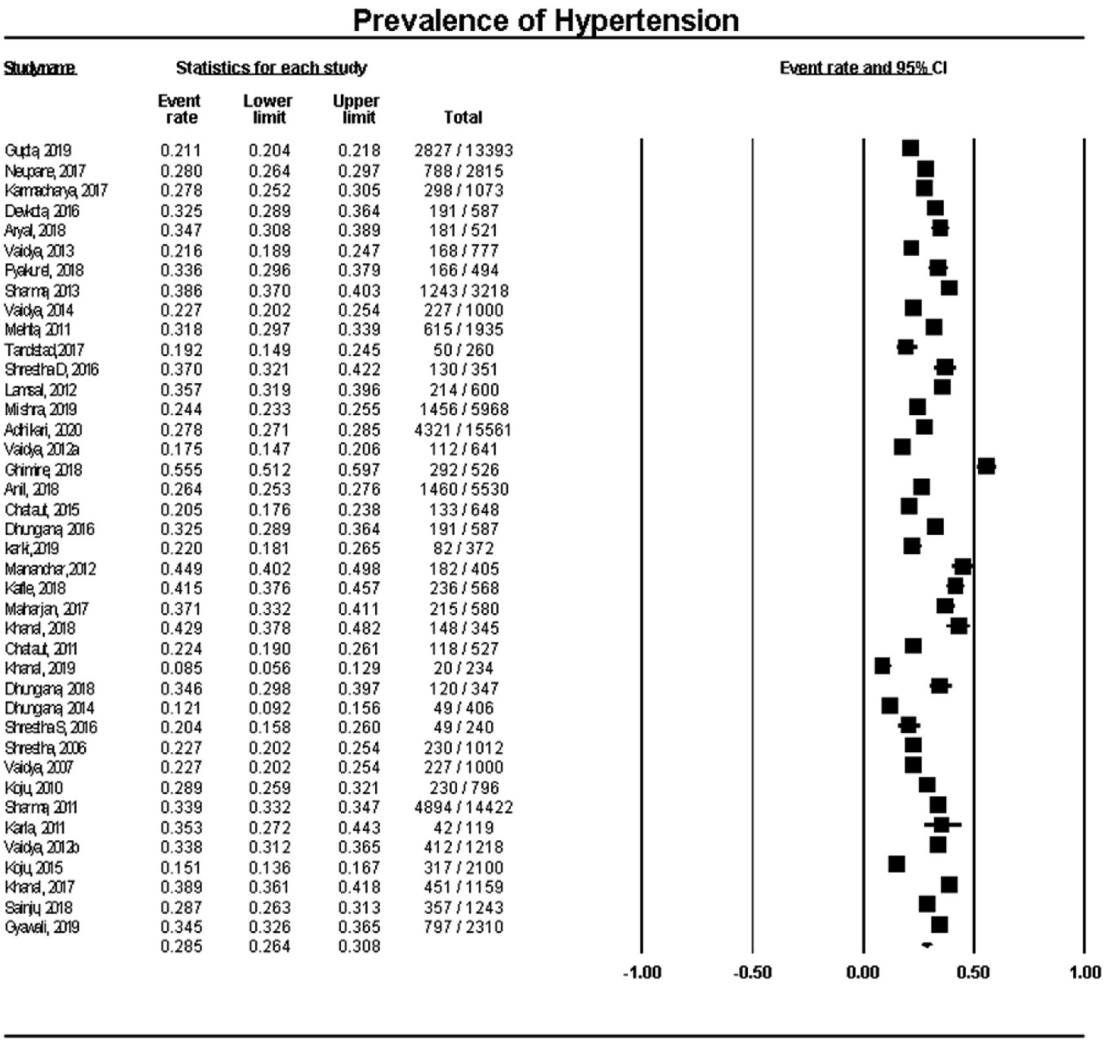

Fig. 2. Prevalence of hypertension.

follow up with physicians. Although a national Multi-Sectoral Action Plan (2014–2020) for prevention of hypertension has been developed, there is still a lack of necessary awareness about this condition and poor compliance with the intake of medication [57]. WHO has emphasized on a core set of interventions addressed at primary care level that should be made accessible to all people based on their need and ability to pay as per the WHO Package of Essential Non-Communicable Disease that was implemented in Nepal in 2016 [58]. However, most of the primary care centers at Nepal are understaffed and have inadequate resources to tackle non-communicable diseases. Further, only 44.4% of patients had optimum control of blood pressure. The optimum control of blood pressure was better than in South Asia and Africa where blood pressure was controlled in 24% and 10.6% of the population.

Hypertension was found more in males compared to females in Nepal which was similar to the study done in 2018. Similarly, multiple studies have found hypertension to be more common in males compared to females [55,56,59]. We also found an increased risk of hypertension with smoking, drinking alcohol and obesity while higher education and exercise were associated with decreased risk of hypertension. A study in China found an increased risk for hypertension with habitual alcohol use, less physical activity and exercise which is concordant with our finding [59]. Our finding of an association of increased BMI with hypertension was similar to the study done by Neupane et al. which showed a significant association of obesity with hypertension throughout different SAARC countries [55]. We found no association of hypertension with stress, vegetarian diet and excess salt intake. This can be explained by the lack of relevant data about these variables in most of our included studies.

Our study has several strengths. Our meta-analysis is the first meta-analysis to provide comprehensive details about the prevalence, awareness and risk factors of hypertension in Nepal. Although a previous study done in 2018 reported the prevalence of hypertension and pre-hypertension in Nepal, it included 23 studies and also did not give an idea about the awareness levels and risk factors of hypertension in Nepal [54]. On the other hand, our meta-analysis includes 40 studies. Also, the findings of our study are significant because it highlights the lack of awareness in more than half of people with hypertension about their condition and that more than two-thirds of hypertensive patients do not take any medications. The following condition is worse than some of the least developed parts in the world including the countries in Africa. There is a real need on the side of the government to prioritize the diagnosis, management and prevention of hypertension throughout the country by focusing on modifiable risk factors. Greater awareness needs to be spread regarding the risks of smoking, regular use of alcohol, less physical activity and obesity. In line with the WHO's package for non-communicable diseases, the primary care centers should be improved, and promotion of health through activities like tobacco cessation, regular physical activity for 30 min, decreased salt intake and a diet rich in vegetables and fruits

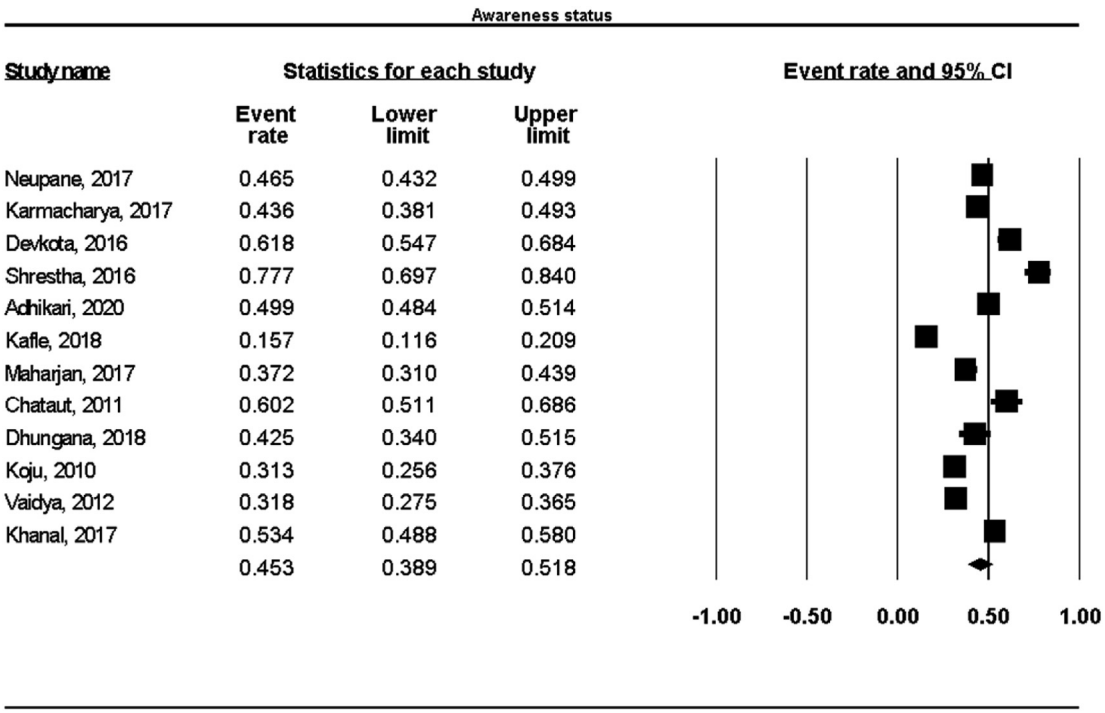

Fig. 3. Meta-analysis pooling data on awareness status of hypertensive patients.

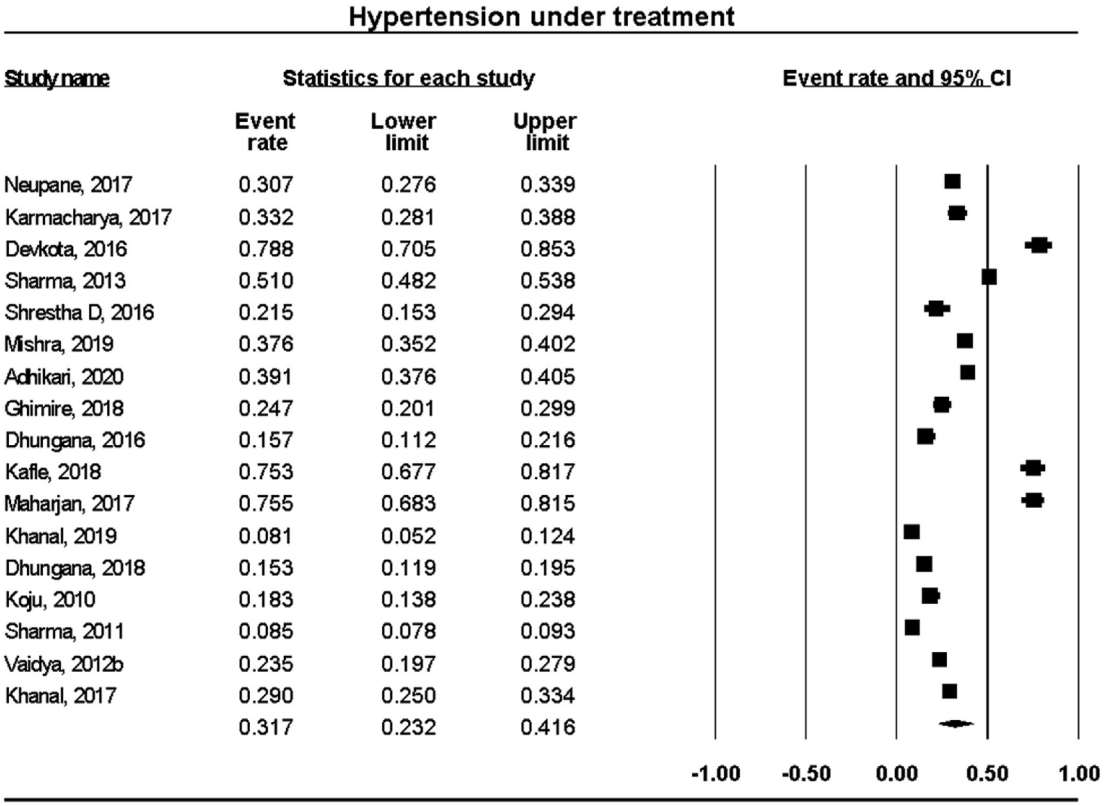

Fig. 4. Meta-analysis pooling data on treatment status of hypertensive patients.

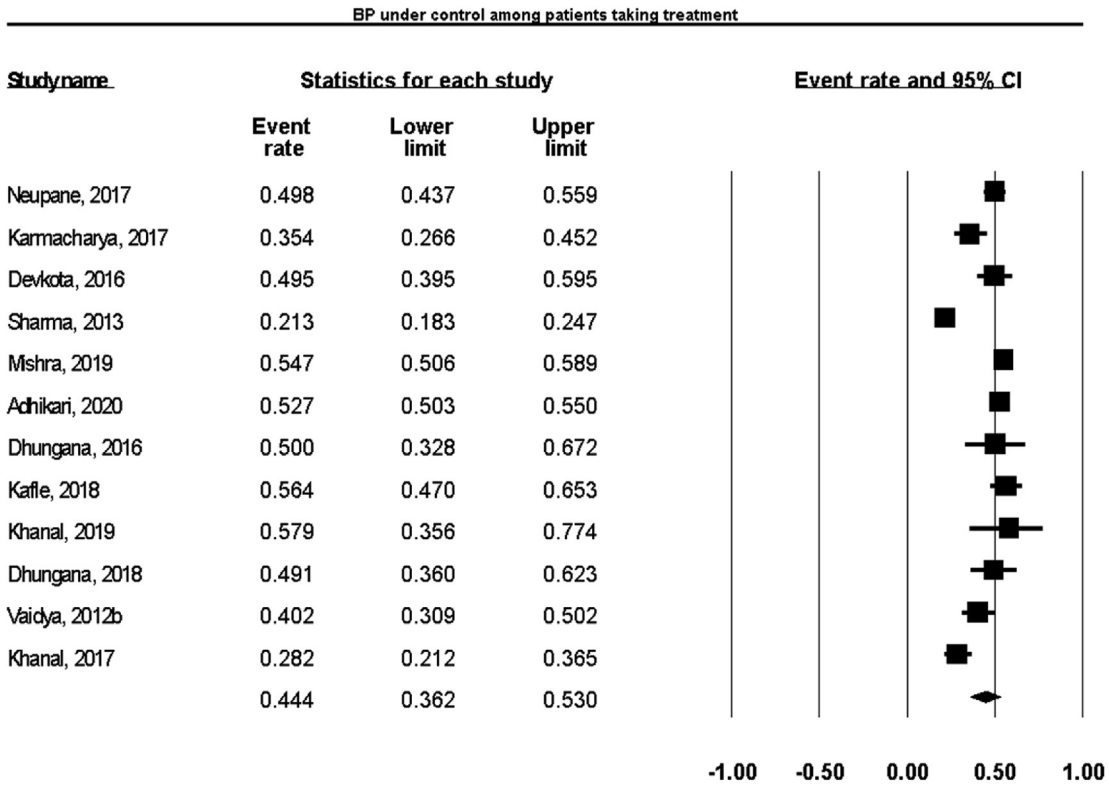

Fig. 5. Meta-analysis pooling data on blood pressure under control among hypertensive patients receiving their treatment.

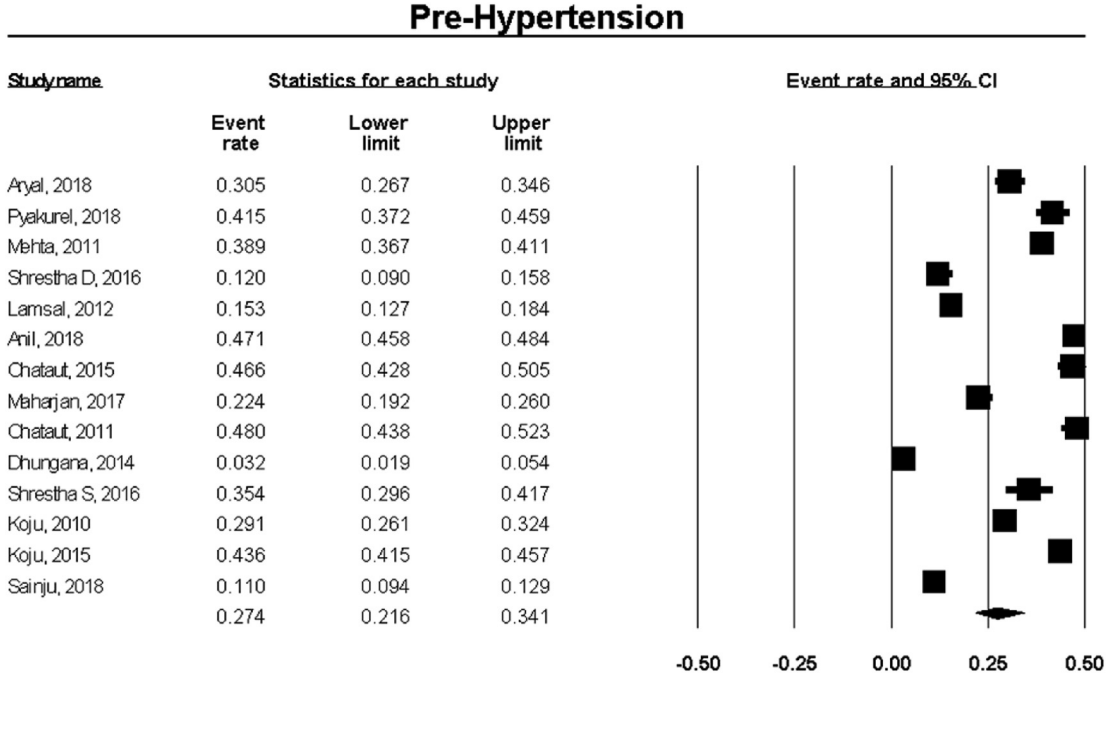

Fig. 6. Meta-analysis pooling data prevalence of pre-hypertension.

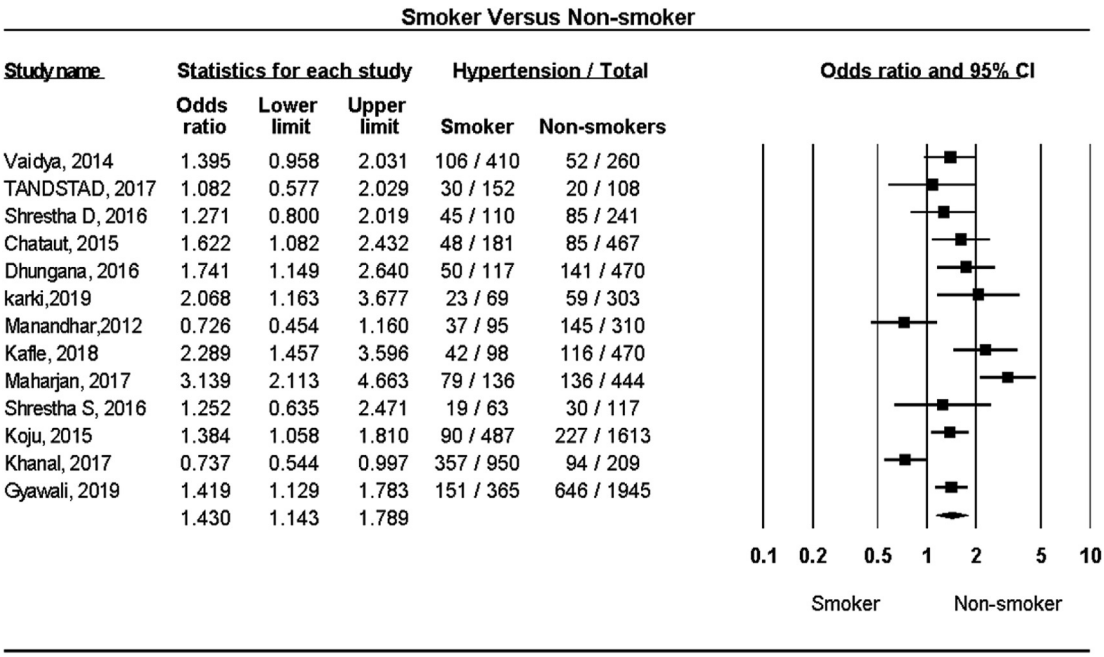

Fig. 7. Meta-analysis pooling smoking status and hypertension.

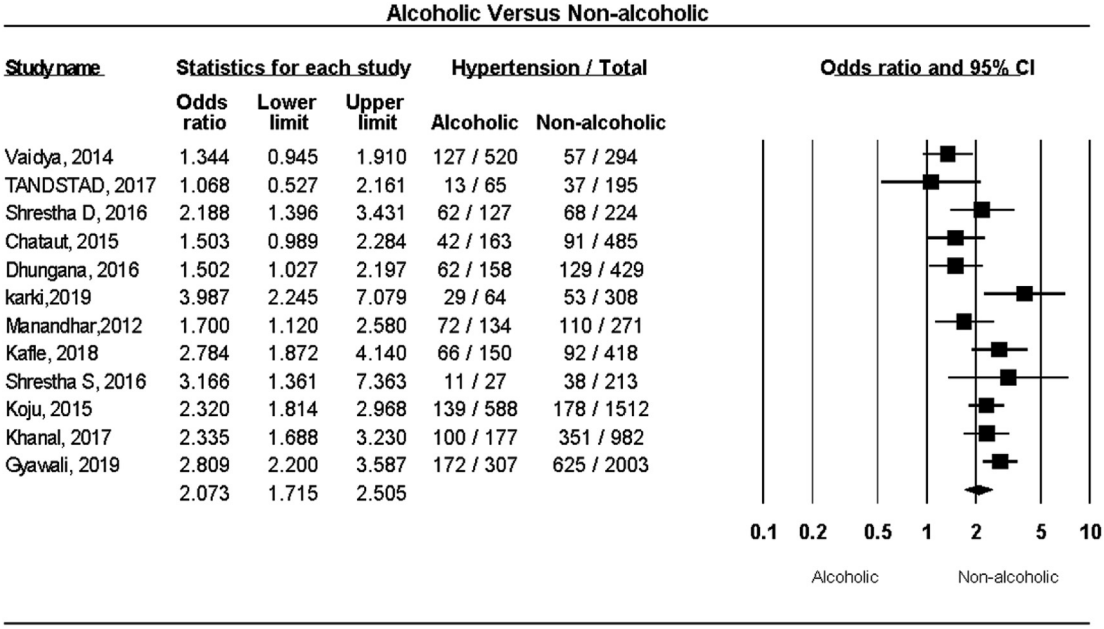

Fig. 8. Meta-analysis pooling alcohol use status and hypertension.

should be done. Patients should be educated by health professionals about the necessity to be compliant with cost-effective medications and about the different cardiovascular risks of untreated hypertension. The alarming findings of our study and the necessary attention it will generate among the concerned authorities add to the significance of our study.

6. Limitations

Our study has several limitations too. Firstly, we included a wide variety of studies with different sample sizes ranging from low to high and people of different socio-demographic features and from various locations. These factors have contributed to significant heterogeneity

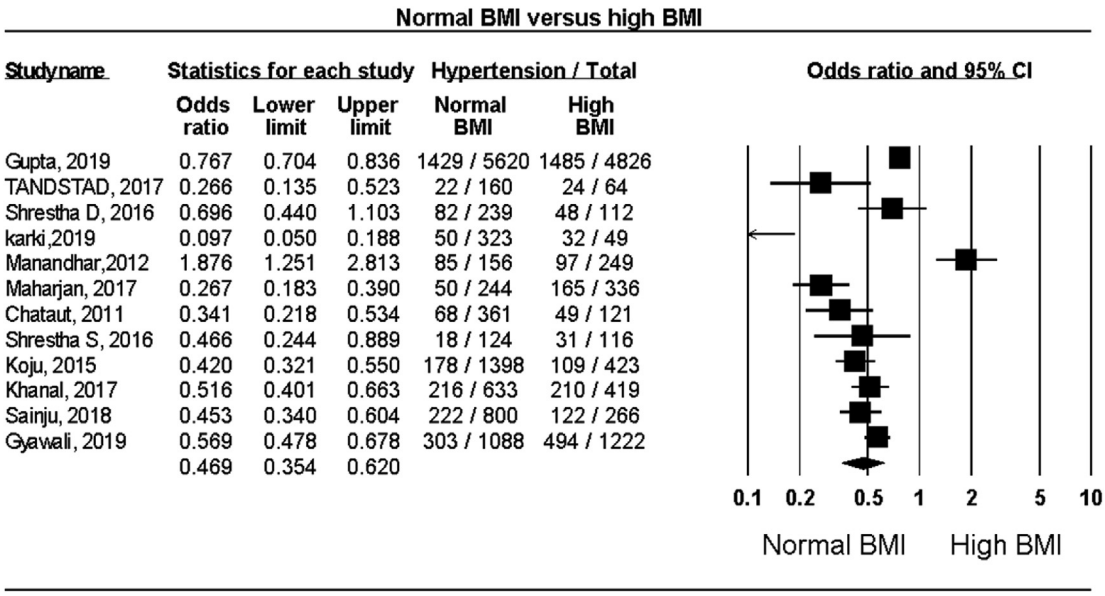

Fig. 9. Meta-analysis pooling relation of BMI and hypertension.

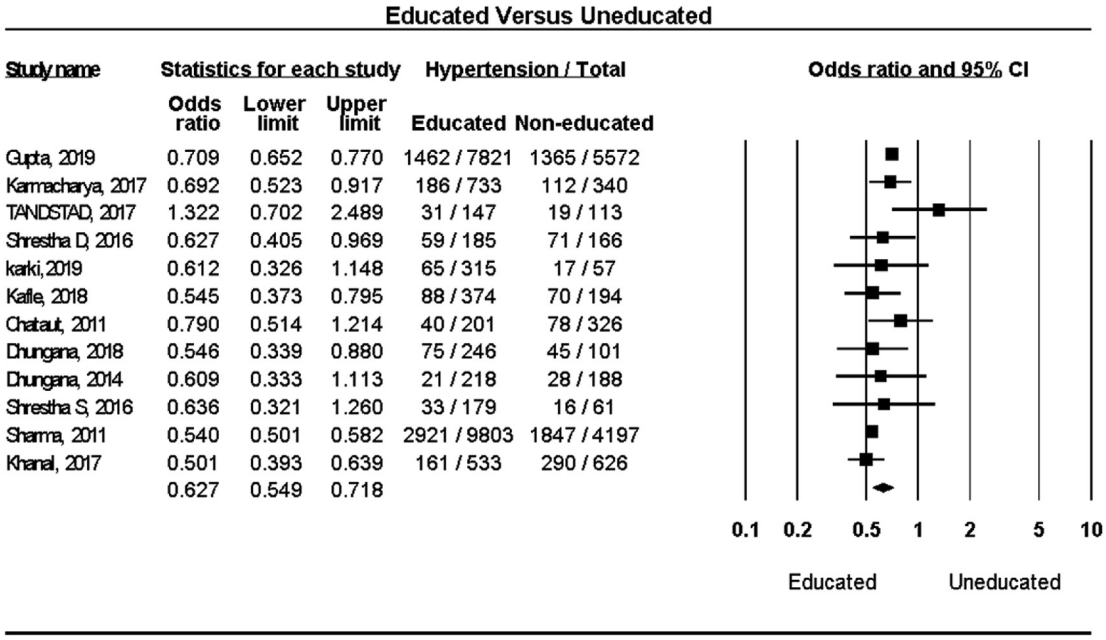

Fig. 10. Meta-analysis pooling relation of education and hypertension.

among the included studies. We also add that studies did not use the current definition of American Heart Association classification of hypertension being all our study were based on prior definition, if had been used would have further increased the prevalence of Hypertension. Also, we could not reach firm association of hypertension with several key factors like added salt, stress and DASH diet because of lack of adequate data. Some of the included studies included males only which might have contributed to the increased association of male gender with hypertension. Nepalese community do have some belief towards traditional cultural belief so try not to begin medication in early may have affected the treatment and its compliance.

7. Conclusion

The prevalence of hypertension and pre-hypertension were found to be 28.52% and 27.5% respectively encompassing more than half of the population. Despite widespread prevalence, the awareness of patients regarding their condition and compliance with treatment were found to be alarmingly low. The optimum control of blood pressure was 44.4% following treatment. Hypertension was associated with male gender, smoking, drinking alcohol and increased BMI. Increased attention should be given by the government and concerned agencies to implement core strategies proposed by WHO to decrease the modifiable risk factors for hypertension.

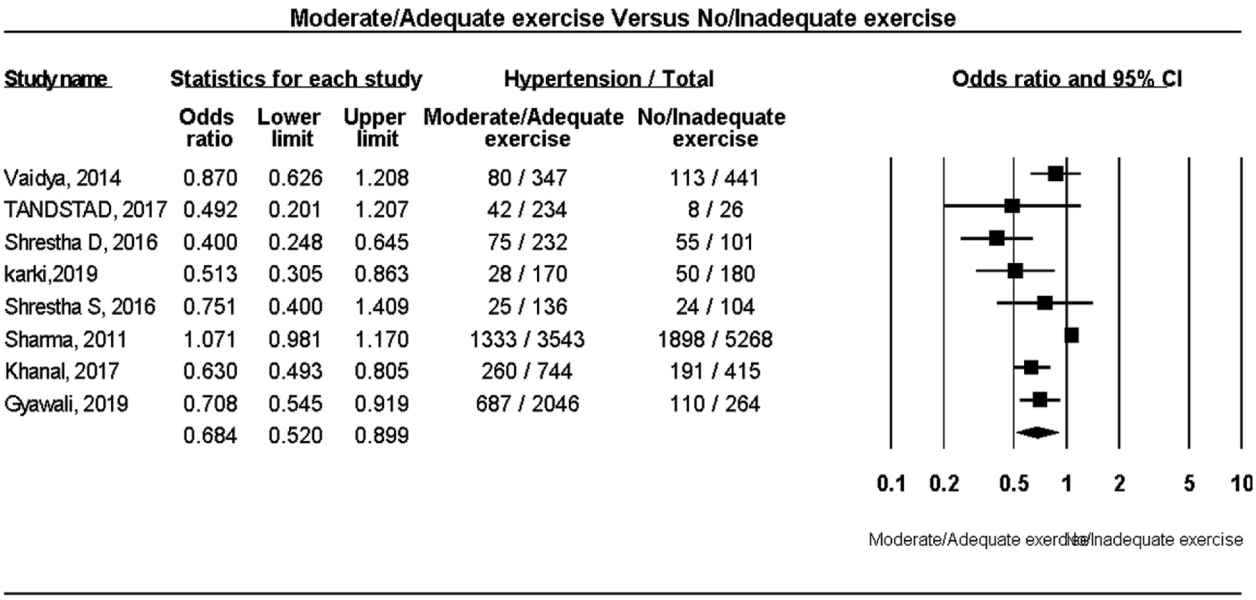

Fig. 11. Meta-analysis pooling relation of exercise and hypertension.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analyzed during the current study is available in supplementary appendix 2.

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Authors' contributions

DBS, PB, and YRS contributed to the concept and design, analysis, and interpretation of data. DBS, PB, AB, SL, MS, BJK, RKB and NP contributed to the literature search, data extraction, review and initial manuscript drafting.

All authors were involved in drafting and revising the manuscript and approved the final version.

Declaration of competing interest

The authors declare that they have no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhip.2021.100119.

References

[1] J.D. Stanaway, A. Afshin, E. Gakidou, 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 392 (10159) (2018) 1923–1994, https://doi.org/10.1016/S0140-6736(18)32225-6.

[2] O.S. Ogah, Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: a review, World J. Cardiol. 4 (12) (2012) 327, https://doi.org/10.4330/wjc.v4.i12.327.

[3] Hypertension, cognitive decline, and dementia: an epidemiological perspective - PubMed. https://pubmed.ncbi.nlm.nih.gov/17506226/. (Accessed 24 November 2020).

[4] F.D. Fuchs, P.K. Whelton, High blood pressure and cardiovascular disease, Hypertension 75 (2) (2020) 285–292, https://doi.org/10.1161/HYPERTENSIONAHA.119.14240.

[5] M.Z.I. Chowdhury, M. Rahman, T. Akter, et al., Hypertension prevalence and its trend in Bangladesh: evidence from a systematic review and meta-analysis, Clin Hypertens 26 (1) (2020) 10, https://doi.org/10.1186/s40885-020-00143-1.

[6] P.M. Kearney, M. Whelton, K. Reynolds, P. Muntner, P.K. Whelton, J. He, Global burden of hypertension: analysis of worldwide data, Lancet 365 (9455) (2005) 217–223, https://doi.org/10.1016/s0140-6736(05)17741-1.

[7] B. Zhou, J. Bentham, M. Di Cesare, 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 389 (10064) (2017) 37–55, https://doi.org/10.1016/S0140-6736(16)31919-5.

[8] K.T. Mills, J.D. Bundy, T.N. Kelly, et al., Global disparities of hypertension prevalence and control, Circulation 134 (6) (2016) 441–450, https://doi.org/10.1161/CIRCULATIONAHA.115.018912.

[9] WHO | Global Status Report on Noncommunicable Diseases 2010, WHO, 2015. http://www.who.int/nmh/publications/ncd_report2010/en/. (Accessed 24 November 2020).

[10] D.F. Stroup, J.A. Berlin, S.C. Morton, et al., For the meta-analysis of observational studies in Epidemiology (MOOSE) group. Meta-analysis of observational studies in Epidemiology. A proposal for reporting, J. Am. Med. Assoc. 283 (15) (2000) 2008–2012, https://doi.org/10.1001/jama.283.15.2008.

[11] Nhlbi. Prevention, reportDetection, Evaluation, and Treatment of High Blood Pressure the Seventh Report of the Joint National Committee on Complete Report.

[12] Cochrane handbook for systematic reviews of interventions | cochrane training. https://training.cochrane.org/cochrane-handbook-systematic-reviews-interventions. (Accessed 24 November 2020).

[13] Critical-appraisal-tools - Critical Appraisal Tools, Joanna Briggs Institute, https://joannabriggs.org/critical-appraisal-tools. (Accessed 24 November 2020).

[14] Karki, Community based observational cross-sectional study ribdikot rural municipality and tansen municipality of palpa district - Google search, 2019. (Accessed 26 November 2020). https://www.google.com/search?sxsrf=ALeKk01DT7u9tTQgqf2wp2tlyfxU1mQjwQ%3A1606407587262&source=hp&ei=o9W_X6TbDdqS9QPCxrU4&q=Karki%2C+2019+%09+Community+based+observational+cross-sectional+study%09+Ribdikot+Rural+Municipality+and+Tansen+Municipality+of+Palpa+district&oq=Karki%2C+2019+%09+Community+based+observational+cross-sectional+study%09+Ribdikot+Rural+Municipality+and+Tansen+Municipality+of+Palpa+district&gs_lcp=CgZwc3ktYWIQA1CnBFinBGCJCWgAcAB4AIABAIgBAJIBAJgBAKABAqABAaoBB2d3cy13aXo&sclient=psy-ab&ved=0ahUKEwjkuOfMzqDtAhVaSX0KHUJjDQcQ4dUDCAc&uact=5.

[15] K. Manandhar, R. Koju, N.P. Sinha, S. Humagain, Prevalence and associated risk factors of hypertension among people aged 50 years and more in Banepa Municipality, Nepal, Kathmandu Univ. Med. J. 10 (39) (2012) 35–38, https://doi.org/10.3126/kumj.v10i3.8015.

[16] R. Kafle, D. Sharma, N. Paudel, S. Sapkota, V. Alurkar, Prevalence and associated risk factors of hypertension in a rural community of western Nepal: a cross sectional

study, J. Adv. Intern. Med. 7 (1) (2018) 11–16, https://doi.org/10.3126/jaim.v7i1.19577.
[17] B. Maharjan, Prevalence and awareness of hypertension among adults and its related risk factors, Community Heal Dev Progr 15 (3) (2017) 242–246, https://doi.org/10.3126/jnhrc.v15i3.18848.
[18] M.K. Khanal, M.S.A. Mansur Ahmed, M. Moniruzzaman, et al., Prevalence and clustering of cardiovascular disease risk factors in rural Nepalese population aged 40-80 years, BMC Publ. Health 18 (1) (2018) 677, https://doi.org/10.1186/s12889-018-5600-9.
[19] J. Chataut, R.K. Adhikari, N.P. Sinha, Prevalence and risk factors for hypertension in adults living in central development region of Nepal, Kathmandu Univ. Med. J. 9 (33) (2011) 13–18, https://doi.org/10.3126/kumj.v9i1.6255.
[20] S. Khanal, K. Rana, M.C. Khanal, A. Prasai, A. Pradhan, M. Shahi, Prevalence of hypertension in adult population of a village of Nepal, J. Nepal Med. Assoc. JNMA 57 (218) (2019) 259–262, https://doi.org/10.31729/jnma.4536.
[21] R.R. Dhungana, P. Thapa, S. Devkota, et al., Prevalence of cardiovascular disease risk factors: a community-based cross-sectional study in a peri-urban community of Kathmandu, Nepal, Indian Heart J. 70 (2018) S20–S27, https://doi.org/10.1016/j.ihj.2018.03.003.
[22] R.R. Dhungana, S. Devkota, M.K. Khanal, et al., Prevalence of cardiovascular health risk behaviors in a remote rural community of Sindhuli district, Nepal, BMC Cardiovasc. Disord. 14 (1) (2014) 92, https://doi.org/10.1186/1471-2261-14-92.
[23] S. Shrestha, R. Devkota, Prevalence of hypertension and its associated risk factors in a sub-urban area of central Nepal, Int J Community Med Public Heal 3 (9) (2016) 2477–2486, https://doi.org/10.18203/2394-6040.ijcmph20163057.
[24] Jansen Tandstad B. Hypertension and its Association with Socioeconimic Factors in Rural Nepal MASTERTHESIS IN PUBLIC HEALTH Hypertension and its Association with Socioeconomic Factors in Rural Nepal.
[25] D.B. Shrestha, S. Dhungel, Prevalence and risk factors of hypertension in hansposa VDC of sunsari district, Nepal, Med. J. Shree Birendra Hosp. 15 (2) (2017) 48–53, https://doi.org/10.3126/mjsbh.v15i2.15406.
[26] K. Lamsal, M. Kafle, Hypertension, as an iceberg disease in the high hilly areas of Nepal, J Inst Med Nepal 34 (3) (2013) 4–7, https://doi.org/10.3126/jiom.v34i3.8906.
[27] S.R. Mishra, N. Shrestha, I.P. Poudyal, et al., May Measurement Month 2017: an analysis of blood pressure screening results in Nepal - South Asia, Eur. Heart J. 21 (Supplement_D) (2019) D83–D85, https://doi.org/10.1093/eurheartj/suz063.
[28] T.B. Adhikari, H. Bhattarai, K. Ranabhat, et al., May Measurement Month 2018: an analysis of blood pressure screening results from Nepal, Eur. Heart J. Suppl. 22 (Supplement_H) (2020) H92–H95, https://doi.org/10.1093/eurheartj/suaa037.
[29] A. Vaidya, U.R. Aryal, A. Krettek, Cardiovascular health knowledge, attitude and practice/behaviour in an urbanising community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot Health Demographic Surveillance Site, BMJ Open 3 (10) (2013), e002976, https://doi.org/10.1136/bmjopen-2013-002976.
[30] S. Ghimire, S.R. Mishra, B.K. Baral, et al., Noncommunicable disease risk factors among older adults aged 60–69 years in Nepal: findings from the STEPS survey 2013, J. Hum. Hypertens. 33 (8) (2019) 602–612, https://doi.org/10.1038/s41371-019-0161-7.
[31] O.M. Anil, R.S. Yadav, N. Shrestha, et al., Prevalence of cardiovascular risk factors in apparently healthy urban adult population of kathmandu, J Nepal Health Res Counc 16 (41) (2019) 438–445, https://doi.org/10.33314/jnhrc.v16i41.1705.
[32] J. Chataut, K. Khanal, K. Manandhar, Prevalence and associated factors of hypertension among adults in rural Nepal: a community based study, Kathmandu Univ. Med. J. 13 (52) (2016) 346–350, https://doi.org/10.3126/kumj.v13i4.16835.
[33] R.R. Dhungana, A.R. Pandey, B. Bista, S. Joshi, S. Devkota, Prevalence and associated factors of hypertension: a community-based cross-sectional study in municipalities of kathmandu, Nepal, Int. J. Hypertens. (2016), https://doi.org/10.1155/2016/1656938.
[34] U.K. Shrestha, D.L. Singh, M.D. Bhattarai, The prevalence of hypertension and diabetes defined by fasting and 2-h plasma glucose criteria in urban Nepal, Diabet. Med. 23 (10) (2006) 1130–1135, https://doi.org/10.1111/j.1464-5491.2006.01953.x.
[35] A. Vaidya, P.K. Pokharel, S. Nagesh, P. Karki, S. Kumar, S. Majhi, War veterans of Nepal and their blood pressure status: a population-based comparative study, J. Hum. Hypertens. 21 (11) (2007) 900–903, https://doi.org/10.1038/sj.jhh.1002235.
[36] R. Koju, K. Manandhar, R. Gurung, P. Pant, T. Bedi, Prevalence of hypertension in semi-urban area of Nepal, Nepal. Heart J. 7 (1) (2013) 35–39, https://doi.org/10.3126/njh.v7i1.8500.
[37] S.K. Sharma, A. Ghimire, J. Radhakrishnan, et al., Prevalence of hypertension, obesity, diabetes, and metabolic syndrome in Nepal, Int. J. Hypertens. 2011 (2011), https://doi.org/10.4061/2011/821971.
[38] Prevalence of risk factors for coronary artery disease in the community in eastern Nepal–a pilot study - PubMed. https://pubmed.ncbi.nlm.nih.gov/21751607/. (Accessed 26 November 2020).
[39] A. Vaidya, R.P. Pathak, M.R. Pandey, Prevalence of hypertension in Nepalese community triples in 25 years: a repeat cross-sectional study in rural Kathmandu, Indian Heart J. 64 (2) (2012) 128–131, https://doi.org/10.1016/S0019-4832(12)60045-5.
[40] R. Koju, K. Manandhar, A. Risal, T.J. Steiner, A. Holen, M. Linde, Undertreated hypertension and its implications for public health in Nepal: nationwide population-based survey, Kathmandu Univ. Med. J. 13 (49) (2015) 3–7, https://doi.org/10.3126/kumj.v13i1.13744.
[41] M.K. Khanal, R.R. Dhungana, P. Bhandari, Y. Gurung, K.N. Paudel, Prevalence, associated factors, awareness, treatment, and control of hypertension: findings from a cross sectional study conducted as a part of a community based intervention trial in Surkhet, Mid-western region of Nepal, PloS One 12 (10) (2017), https://doi.org/10.1371/journal.pone.0185806.
[42] N.K. Sainju, R.K. Shah, S.K. Joshi, Screening for hypertension and obesity in rural population of Nepal, Kathmandu Univ. Med. J. 16 (61) (2018) 4–7. https://europepmc.org/article/med/30631008. (Accessed 26 November 2020).
[43] B. Gyawali, S.R. Mishra, S. Ghimire, et al., The burden and correlates of multiple cardiometabolic risk factors in a semi-urban population of Nepal: a community-based cross-sectional study, Sci. Rep. 9 (1) (2019) 15382, https://doi.org/10.1038/s41598-019-51454-9.
[44] R. Das Gupta, S.S. Haider, M.R. Hashan, M.A. Rahman, M. Sarker, Association between height and hypertension in the adult Nepalese population: findings from a nationally representative survey, Heal Sci Reports 2 (12) (2019), https://doi.org/10.1002/hsr2.141.
[45] D. Neupane, A. Shrestha, S.R. Mishra, et al., Awareness, prevalence, treatment, and control of hypertension in Western Nepal, Am. J. Hypertens. 30 (9) (2017) 907–913, https://doi.org/10.1093/ajh/hpx074.
[46] B.M. Karmacharya, R.P. Koju, J.P. LoGerfo, et al., Awareness, treatment and control of hypertension in Nepal: findings from the dhulikhel heart study, Heart Asia 9 (1) (2017) 1–8, https://doi.org/10.1136/heartasia-2016-010766.
[47] S. Devkota, R.R. Dhungana, A.R. Pandey, et al., Barriers to treatment and control of hypertension among hypertensive participants: a community-based cross-sectional mixed method study in municipalities of kathmandu, Nepal, Front Cardiovasc Med 3 (2016) 1, https://doi.org/10.3389/fcvm.2016.00026.
[48] N. Aryal, M. Weatherall, Y.K.D. Bhatta, S. Mann, Blood pressure and hypertension in people living at high altitude in Nepal, Hypertens. Res. 42 (2) (2019) 284–291, https://doi.org/10.1038/s41440-018-0138-x.
[49] A. Vaidya, Is ethnicity an important determinant of high blood pressure in Nepalese population? A community-based cross-sectional study in Duwakot, Nepal, Kathmandu Univ. Med. J. 10 (37) (2012) 20–23, https://doi.org/10.3126/kumj.v10i1.6908.
[50] P. Pyakurel, D.K. Yadav, J. Thapa, et al., Prevalence and associated risk factor of hypertension among individuals of age 18-59 years in South-eastern Nepal: a cross-sectional study, Nepal. Heart J. 16 (1) (2019) 19–26, https://doi.org/10.3126/njh.v16i1.23894.
[51] S.K. Sharma, S. Dhakal, L. Thapa, et al., Community-based screening for chronic kidney disease, hypertension and diabetes in dharan, J. Nepal Med. Assoc. JNMA 52 (5) (2013) 205–212, https://doi.org/10.31729/jnma.548.
[52] Exploring the iceberg of hypertension: a community based study in an eastern Nepal town - PubMed. https://pubmed.ncbi.nlm.nih.gov/18604053/. (Accessed 26 November 2020).
[53] Hyperglycemia, glucose intolerance, hypertension and socioeconomic position in eastern Nepal - PubMed. https://pubmed.ncbi.nlm.nih.gov/21323183/. (Accessed 26 November 2020).
[54] Y. Huang, P. Guo, B.M. Karmacharya, S.R. Seeruttun, D.R. Xu, Y. Hao, Prevalence of hypertension and prehypertension in Nepal: a systematic review and meta-analysis, Glob Heal Res Policy 4 (1) (2019) 11, https://doi.org/10.1186/s41256-019-0102-6.
[55] D. Neupane, C.S. McLachlan, R. Sharma, et al., Prevalence of hypertension in member countries of South asian association for regional cooperation (SAARC), Medicine (Baltim.) 93 (13) (2014) e74, https://doi.org/10.1097/MD.0000000000000074.
[56] C.K. Chow, K.K. Teo, S. Rangarajan, et al., Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries, JAMA, J. Am. Med. Assoc. 310 (9) (2013) 959–968, https://doi.org/10.1001/jama.2013.184182.
[57] World Health Organization, Multisectoral action plan... - Google scholar. https://scholar.google.com/scholar_lookup?title=Multisectoral Action Plan for the Prevention and Control of Non-Communicable Diseases %282014–2020%29&pages=15-16&publication_year=2014. (Accessed 26 November 2020).
[58] S.R. Upreti, G.R. Lohani, A. Magtymova, L.P. Dixit, Strengthening policy and governance to address the growing burden of diabetes in Nepal, WHO South-East Asia J public Heal 5 (1) (2016) 40–43, https://doi.org/10.4103/2224-3151.206551.
[59] J. Wang, L. Zhang, F. Wang, L. Liu, H. Wang, Prevalence, awareness, treatment, and control of hypertension in China: results from a national survey, Am. J. Hypertens. 27 (11) (2014) 1355–1361, https://doi.org/10.1093/ajh/hpu053.