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Research Article

Cost-Effectiveness of Comprehensive Screening of General Population for Hypertension: Can it Save Money and Life? Systematic Review of Pharmacoeconomic Studies

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Abstract

Background: Hypertension is one of the major modifiable risk factors contributing for development of ischemic heart disease, diabetes, kidney disease, cerebrovascular disease and peripheral arterial disease. Early screening, detection and treatment of hypertension is effective for control of the disease progression. However, there is no robust evidence on whether screening general population for hypertension is cost-effective or not. Therefore, this systematic review was conducted to generate evidence on cost effectiveness of population-based screening for hypertension.

Methods: PubMed/Medline, Scopus, Web of sciences and Google Scholar were searched from January 2000 to 11 December 2019. Two investigators independently selected and reviewed pharmacoeconomic studies.

Results: Eleven studies were included in this review. All studies showed that screening people who are 40 years or older with high risk for cardiovascular disease is cost-effective. Screening of general adult population for hypertension is not-cost effective. Screening in developing countries is challenged by limited access to health care, in adequate health task force, poor financial protection and low health literacy of the population. Integrating multiple interventions, task shifting and using local opportunities for addressing the target population are important possibilities to improve opportunistic screening.

Conclusion: There is no adequate evidence to recommend screening of asymptomatic adults with no risk factor hypertension. Screening high risk populations aged 40 years and older at least annually is cost-effective in reducing hypertension and associated cardiovascular disease morbidity and mortality in developed and developing countries. Therefore, more strong economic evaluations from different perspectives are required to recommend general screening for hypertension.

Keywords: *Screening Asymptomatic Populations; Hypertension; Cardiovascular Disease; Developing Countries*

Abbreviations

CEA: Cost Effectiveness Analysis; CBA: Cost Benefit Analysis; CUA: Cost Utility Analysis; CVD: Cardiovascular Diseases; QALY: Quality Adjusted Life Years; ICER: Incremental Cost Effectiveness Ratio; RR: Relative Risk; CI: Confidence Interval; DALY: Disability Adjusted Life Years; MeSH: Medical Subject Heading; SSA: Sub-Saharan Africa; WHO: World Health Organization; PEN: Package of Essential Noncommunicable Diseases; CHD: Coronary Heart Disease; ACEIs: Angiotensin Converting Enzyme Inhibitors

Background

Hypertension is one of the major risk factors contributing for development of ischemic heart disease, diabetes, kidney disease, cerebrovascular disease and peripheral arterial disease. Opportunistic screening and treating population with high-risk factors currently practiced for preventing and halting the disease progress after recommendations from world health organization and other national guidelines. Despite the introduction of this approach the disease incidence and prevalence is increasing. This calls for action to increase the detection rate, prevention and treatment options [1,2].

Hypertension is probably the most researched modifiable risk factor for ischemic heart disease with poor control over the disease incidence and prevalence of the disease. Current studies indicated that mean blood pressure of the global adult population is in pre-hypertension stage [3]. Globally only one out of seven (14.28%) people with high blood pressure have achieved good control [4,5]. Hypertension treatment and control in developing countries are poor. According to the household survey report, health system in Sub-Saharan Africa (SSA) has the worst performance with only 29.9% of participants received treatment, and 10.3% of participants achieved control of their hypertension [5].

Delayed detection of hypertension after development of significant cardiovascular events is one of the avoidable bottle necks for blood pressure control [6]. Early identification of cardiovascular disease (CVD) risk is important to reach people in need of treatment [7]. There is no clear evidence on cost effectiveness of population-based screening for hypertension as part of early detection in developing countries [8].

The burden of cardiovascular disease (CVD) has shifted toward low and middle-income countries [9,10]. There are cost-effective pharmacological therapies to control blood pressure and prevent related cardiovascular disease morbidity and mortality. This requires early screening before development significant cardiovascular events. Studies indicated that there is insufficient Evidence to confirm the value of population screening for hypertension in low and middle income settings. To save Limited resources and provide evidence on cost-effectiveness population screening, especially in low- and middle-income countries is important [8,11].

Prevention and management of raised blood pressure can significantly reduce the morbidity and mortality related to cardiovascular diseases [12]. The question is how we can address these patients before development of cardiovascular events. Can we screen general population for raised blood pressure with available health budget which is already stressed with a huge burden of infectious diseases and malnutrition in developing countries? Screening method so far applied by guidelines of different countries has not reduced the increasing burden of raised blood pressure and its consequences. Therefore, this systematic review was conducted to synthesize evidence on cost-effectiveness of screening general population for hypertension.

Methods

Data sources and search strategy

We have searched the PubMed/Medline, Scopus, Web of Science and Google scholar with the following search query: Cost-effectiveness AND of AND population AND based AND screening AND for AND hypertension.

PICO for the systematic review

- **Population:** Adult Population age greater than or equal to 18 years.
- **Intervention:** Population based screening for hypertension for adult's age greater than or equal to 18 years with no history of hypertension or cardiovascular diseases and diabetes.

- **Comparison**: Opportunistic screening or screening patients visiting health facility for any for hypertension or Routine chronic care.
- **Outcomes:** Quality of Life, Quality adjusted life years (QALY) gained or disability adjusted life years (DALY) averted.

Study types

Cost-effectiveness analysis, Cost-benefit analysis, Cost-utility Analysis and budget impact analysis.

Inclusion and exclusion criteria

- Population based screening (scheduled or opportunistic) for asymptomatic adults are included.
- Population based screening (scheduled or opportunistic) for asymptomatic children are excluded.
- Articles evaluating only high-risk population are excluded.
- Articles that are not Pharmacoeconomic studies (CEA, CBA, CUA) are excluded.
- Guidelines, Review articles, Short communications and Conference proceedings are excluded.
- Articles that don't met quality evaluation criteria are excluded.

Study selection

From total of 234 articles identified by literature search 44 potentially relevant articles were selected, after applying the inclusion exclusion criteria listed above only 17 articles were found to be relevant. With intention to have strong evidence we applied quality check for selected 17 articles and only 11 were found to meet our quality check and considered for review [13] (Figure 1). Two authors (MD, MM) independently reviewed each abstract based on pre-specified inclusion and exclusion criteria. In case of disagreement on quality of the article two authors discussed in presence of the third author (SN). We included good-quality Pharmacoeconomic studies written in English language since 2000 that assessed the effectiveness of population-based hypertension screening in asymptomatic general adult population without a history of CVD or diabetes.

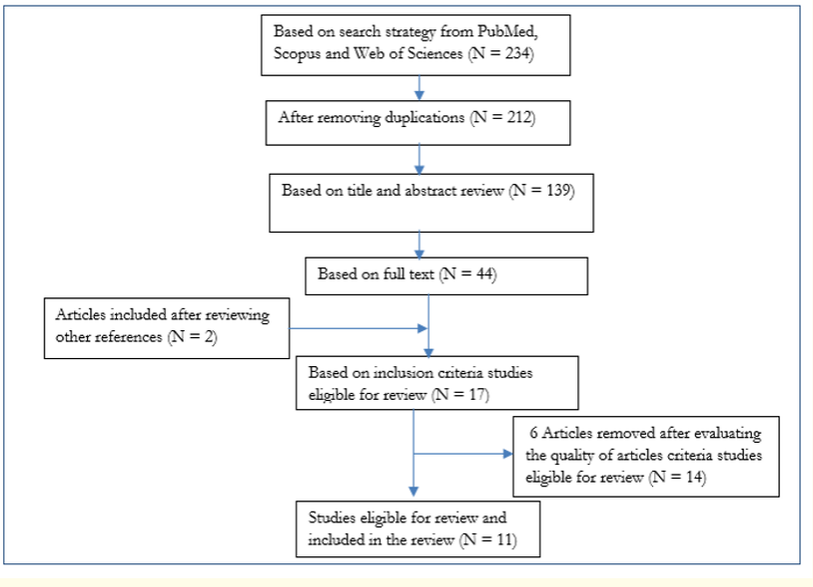

Figure 1: *PRISMA Flowchart representing the result of search and the number of articles excluded and eligible for review.*

Data extraction and quality assessment

Two Authors collected baseline information, population characteristics, intervention details, disease incidence, mortality data and cost- effectiveness data from all included studies into a standardized evidence table. These authors independently assessed each study's quality as "good" or "poor" by using predefined quality criteria based on quality appraisal criteria of Pharmacoeconomic studies [14-16] (Table 1). We excluded all poor-quality Pharmacoeconomic studies. In general, a good-quality studies did not meet at most one pre-specified criteria. The study is labeled as having poor-quality if it did not meet at least two criterion. We used the Pharmacoeconomic studies quality appraisal criterial and Criteria for assessment of methodological quality of economic evaluations for quality evaluation and disagreements among us are managed through discussion in the presence of third author.

S. No	Criteria	Reference										
		Ferket, BS., *et al.* 2016 [18]	**Dukpa W., *et al.* 2015 [19]**	**Kypridemos C., *et al.* 2018 [20]**	**Rattanavipapong W., *et al.* 2016 [21]**	**Howard K., *et al.* 2010 [22]**	**Nguyen TPL., *et al.* 2016 [23]**	**Van Buuren S., *et al.* 2006 [24]**	**Rosendaal NTA., *et al.* 2016 [25]**	**Van de Vijver S., *et al.* 2013 [26]**	**Dehmer SP., *et al.* 2017 [27]**	**Wang YC., *et al.* 2011 [28]**
1	Is the title complete (answer, What, Where, How, in Whom)?	N	Y	Y	Y	N	Y	N	Y	N	N	Y
2	Is the study population clearly described?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Are competing alternatives clearly described?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	Is a well-defined research question posed in answerable form?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	Is the economic study design appropriate to the stated objective?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	Is the chosen time horizon appropriate to include relevant costs and consequences?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	Is the actual perspective chosen appropriate?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	Are all important and relevant costs for each alternative identified?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	Are all costs measured appropriately in physical units?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	Are costs valued appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11	Are all important and relevant outcomes for each alternative identified?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

12	Are all outcomes measured appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
13	Are outcomes valued appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
14	Is an incremental analysis of costs and outcomes of alternatives performed?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
15	Are all future costs and outcomes discounted appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
16	Are all important variables, whose values are uncertain, appropriately subjected to sensitivity analysis?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
17	Are Limitations addressed?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
18	Do the conclusions follow from the data reported?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
19	Does the study discuss the generalizability of the results to other settings and patient/client groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
20	Does the article indicate that there is no potential conflict of interest of study researcher(s) and funder(s)?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
21	Are ethical and distributional issues discussed appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Total quality score	95.2%	100%	100%	100%	95.2%	100%	95.2%	100%	95.2%	95.2%	100%

Table 1: *Rating quality of included pharmacoeconomic studies based on quality appraisal criteria of pharmacoeconomic studies.*

Risk of bias assessment

We evaluated the risk of bias by using A critical appraisal tool to assess the quality of cross-sectional studies (AXIS) which is developed by experts [17]. The AXIS tool contains 20 questions. Of which six questions are related to the possible introduction of bias [17]. All authors evaluated the risk of bias independently. Based on the questions addressing possibility bias questions Pharmacoeconomic studies included in this review have low risk of bias (Table 2).

S. No	Study reference	Country	Study design	Perspective	Participants	Measured outcome	Frequency of screening	Findings	Recommendations
1	Ferket BS., *et al*. 2016 [18]	UK	Microsimulation model	Payer	40-69 years	ICER/QALY gained	Every 5 years	Periodic screening at 10-year CVD risk equivalent of 20% costed, £145/QALY gained AND Periodic screening at CVD risk equivalent of 10% costed £11, 797/QALY gained	Periodic risk assessment with lower risk thresholds to initiate preventive drugs is unlikely to be cost-effective
2	Dukpa W., *et al*. 2015 [19]	Thailand	Model-based economic evaluation	Societal	40 years and older	ICER/DALY averted	annual	Universal screening for 40 years and older ICER = 112,906/DALY averted (BTN)= Bhutanese Ngultrum	Universal screening for 40 years and older is cost-effective
3	Kypridemos C., *et al*. 2018 [20]	UK	Dynamic stochastic microsimulation policy model	Payer	40-74 years	ICER/QALY gained	every 5 years	Screening and risk stratification ICER = 11,000/QALY gained	Screening and risk stratification are dominated by healthy behavior interventions
4	Rattanavipapong W., *et al*. 2016 [21]	Indonesia	A decision tree and Markov model combined	Societal	40 years and older	ICER/QALY gained	Annual	Screening for diabetes and hypertension is cost-saving at the ICER of 14.22 million IDR per DALY averted	Screening for diabetes and hypertension is cost-saving compared to no screening
5	Howard K., *et al*. 2010 [22]	Australia	Markov modeling study	Payer (Funder)	50-69 Years	ICER/QALY gained	annual	Screening and intensive treatment of hypertension = $ 491/QALY	Screening for hypertension, diabetes and protein urea followed by ACEI therapy is cost effective
6	Nguyen TPL., *et al*. 2016 [23]	Vietnam	Decision tree and Markov model combined	Health service provider	55 years and above	ICER/QALY gained	Biannually	Screening is cost effective= $ 758,695 per QALY gained over ten years	Screening and increasing treatment coverage by 20% cost-effective
7	Van Buuren S., *et al*. 2006 [24]	Holland	Simulation study	Provider	60 years and older	ICER/QALY gained	Annual	Screening individuals with; diabetes, previous CHD, age > 60, familial CVD, high cholesterol, history of hypertension is cost effective	It is not cost-effective to measure the BP of all patients, regardless of age, who visit the general practitioner
8	Rosendaal NTA., *et al*. 2016 [25]	Nigeria	Markov modeling	Provider	30-79 years	ICER/DALY averted	Single	Presence of hypertension in combination with a CVD risk of >20% (risk-based strategy is cost effective with $ 1406-7815/DALY averted	Screening may be cost-effective with wide range of uncertainty
9	Van de Vijver S., *et al*. 2013 [26]	Kenya	Theoretical Modeling study	Payer	35 years and older	ICER/DALY averted	Annual	The service delivery package is cost-effective with of 760 -1,200 USD/DALY averted	Home based screening by using trained community health workers is cost-effective
10	Dehmer SP., *et al*. 2017 [27]	US	Integrated, micro-simulation model	Societal	18 Years and older	ICER/QALY gained	annual	Hypertension screening and treatment ICER = $48,500/QALY gained	Hypertension screening and treatment is cost-effective
11	Wang YC., *et al*. 2011 [28]	US	Simulation modeling study	Payer	15 years and older	ICER/QALY gained	Variable	Screen and treat strategy is moderately cost-effective with mean cost = $32500/QALY gained	The strategy is dominated by population measures like physical education and salt reduction

Table 2: *Summery analytic approaches and major outcome measures in Studies conducted to evaluate cost-effectiveness of screening general population for hypertension, form 2000 - December 11/2019 years.*

Data synthesis and analysis

The results were systematically analyzed, described and summarized qualitatively. We stratified results by method of (regular or opportunistic) screening, Perspective of Pharmacoeconomic evaluation, target population included, frequency of screening and method of Pharmacoeconomic studies used and synthesized the results of included studies by examining outcomes and the respective recommendations.

Results

We screened 212 abstracts identified from search databases, reviewed 139 full-text of relevant articles, and included 11 articles in the final review. All studies involved modeling either markov's modeling or simulation modeling. The results are described by QALY gained, or DALYs averted. Concerning the target populations four studies included people aged 40 years and above [18-21], three studies included people aged 50 years and above [22-24], two studies included age 30 years and above [25,26] and two studies included age 15 years and above (Table 3) [27,28].

S. No	References	Risk of bias score	Percent of authors agreed
1	Ferket BS., *et al*. 2016 [18]	Low	100%
2	Dukpa W., *et al*. 2015 [19]	Low	100%
3	Kypridemos C., *et al*. 2018 [20]	Low	100%
4	Rattanavipapong W., *et al*. 2016 [21]	Low	100%
5	Howard K., *et al*. 2010 [22]	Low	100%
6	Nguyen TPL., *et al*. 2016 [23]	Low	100%
7	Van Buuren S., *et al*. 2006 [24]	Low	100%
8	Rosendaal NTA., *et al*. 2016 [25]	Low	100%
9	Van de Vijver S., *et al*. 2013 [26]	Low	100%
10	Dehmer SP., *et al*. 2017 [27]	Low	100%
11	Wang YC., *et al*. 2011 [28]	Low	100%

Table 3: *Rating risk bias of Pharmacoeconomic studies included based on a critical appraisal tool to assess the quality of cross-sectional studies (AXIS).*

Note*: Low risk means the study has no concerns of bias asper the AXIS risk of bias assessment questions, Intermediate means, there is one concern among six questions of AXIS tool regarding the given study.*

Micro-simulation modeling study conducted in UK to predict lifetime CVD events, diabetes, and death in 259 146 asymptomatic UK Biobank participants aged 40 - 69 years showed that Periodic screening at 10-year CVD risk equivalent of 20% costed, £145/QALY gained and Periodic screening at CVD risk equivalent of 10% costed £11, 797/QALY gained. Periodic risk assessment using lower risk thresholds is not cost-effective [18].

Another study conducted in Australia showed that Screening and intensive treatment of hypertension resulted in ICER of $491/QALY gained. Primary care screening for hypertension, diabetes and protein urea between ages 50 and 69 years followed by ACEI therapy is cost effective [22].

Model-based economic evaluation conducted in Thailand (Bhutan) showed that screening people who are 40 years and above, are overweight, obese for diabetes and hypertension was cost-effective. Expanding opportunistic screening to the extent of universal coverage for target population is cost-effective [19].

Microsimulation modelling study in NHS showed that, Screening and risk stratification resulted in ICER of 11,000/QALY gained. Screening and risk stratification of general population aged 40 - 74 years are dominated by healthy behavior interventions. Implementation of general screening for population aged 40 - 74 years is neither equitable nor cost-effective [20].

Cost-effectiveness analysis of screening for and managing identified hypertension for cardiovascular disease prevention in Vietnam showed that screening for hypertension resulted in cost saving of $758,695 per QALY gained in ten year horizons. Screening at above 55 years and older with increasing treatment coverage by 20% is cost-effective [23].

An Economic Evaluation of the PEN Program in Indonesia showed that implementing screening targeted at high-risk groups of population aged 40 and above is cost-effective when compared with no screening. Screening will result in cost savings for the government and a possibility to reallocate resources to the country's priority health concerns, consequently leading to better health outcomes [21].

A Costs and cost-effectiveness of hypertension screening and treatment in adults with hypertension in rural Nigeria showed that the ICER for the first (hypertension and risk based) and second (risk based) strategy respectively ranged from USD $1,406 to US $7,815 and USD $732 to USD $2,959/DALY averted, depending on the assumptions on risk reduction after treatment and compared to no access to antihypertensive treatment. Cost-effectiveness of Screening for hypertension was sensitive to changes in underlying assumptions with a wide range of uncertainty [29].

Simulation study conducted in Holland showed that screening individuals 60 years or older with; diabetes, previous CHD, familial CVD, high cholesterol, history of hypertension is cost effective and lifesaving (increased healthy life expectancy). It is not cost-effective to measure the BP of all patients, regardless of age, who visits the general practitioner [24].

Introducing a model of cardiovascular prevention in Nairobi's slums by integrating a public health and private-sector approach study showed that a home-based screening service package resulted in 760 to 1,200 USD/DALY averted. Home based screening for general population aged 35 years and older by using trained community health workers is cost-effective [26].

Microsimulation modeling study conducted to evaluate Health Benefits and Cost-Effectiveness of Asymptomatic Screening for Hypertension and High Cholesterol and Aspirin Counseling for Primary Prevention in US showed that Health impact is highest for hypertension screening and treatment (15,600 QALYs), but is closely followed by cholesterol screening and treatment (14,300 QALYs). Cost-effectiveness for cholesterol and hypertension screening and treatment is $33,800 per QALY and $48,500 per QALY, respectively [27].

Effectiveness and cost-effectiveness of blood pressure screening in adolescents in the United States showed that Hypertension screening and treatment ICER of $48,500/QALY gained. Routine Hypertension screening and treatment for adults 18 years and above is cost-effective was dominated by population-wide strategies such as salt reduction and increasing physical education [28].

Discussion

In this review we described cost-effectiveness of screening general population for hypertension by using Pharmacoeconomic studies addressing screening asymptomatic adult individuals for hypertension on December 11, 2019. All studies reported favorable results for screening asymptomatic adults for hypertension. Most of the studies agreed on cost-effectiveness of screening adults aged 40 years and older. Screening of general adult population for hypertension is not-cost effective [18-28].

Five out of 11 articles determined the cost-effectiveness from payer perspective, 3 studies from societal perspective and three from provider perspective. Only three studies are conducted in developing countries Vietnam [23], Nigeria [25] and Kenya [26].

One study conducted in UK showed that showed that Periodic screening of asymptomatic individuals aged 40 - 69 years at CVD risk equivalent of 10% costed £11, 797/QALY gained [18]. Periodic screening for low risk population or adults aged below 40 years with no history cardiovascular disease or diabetes is not-effective. This is because people 40 years and above by default enter into risk category CVD risk equivalent of more than 10% [4]. However, another study showed that screening and risk stratification of general population aged 40 - 74 years is neither equitable nor cost-effective [20]. This could be explained by separate screening and stratification of patients without providing counseling services on health-related behavior and life style. As NHS system involves Universal financing system and internal privatization, service providers usually take a great deal of their time in stratification and categorizing them to different diagnostic related groups to make profit [30].

An economic evaluation conducted in Thailand showed that screening people who are 40 years or older with overweight, obesity for diabetes and hypertension is cost-effective. Expanding opportunistic screening to universal screening for target population is cost-effective [19]. This is in line with world heart health recommendation [12]. However, this screening in developing countries is challenged by limited access to health care, in adequate health task force, poor financial protection and low health literacy of the population [2]. Integrating multiple interventions together, shifting screening task to low level trained professionals and using local opportunities for addressing the target population are important possibilities for decreasing the burden of hypertension and associated morbidity and mortality [6,7,31-33].

An Economic Evaluation of the PEN Program in Indonesia showed that targeted screening of high-risk groups of population aged 40 and above is cost-effective. Screening will result in cost savings for the government and a possibility to reallocate resources to the country's priority health concerns, consequently leading to better health outcomes [21]. This study directly addresses our basic question screening at developing countries with limited health budget and screening adults above 40 years of age can be done without casing significant change in health budget with good return in investment.

Modeling study conducted in Australia showed that screening and intensive treatment of hypertension resulted in ICER of $491/QALY gained. Primary care screening for hypertension, diabetes and protein urea between ages 50 and 69 years followed by ACEI therapy is cost-effective [22]. Cost-effectiveness analysis of screening for and managing identified hypertension for cardiovascular disease prevention in Vietnam showed cost-effectiveness of screening at age 55 years and above with or without increasing treatment coverage by 20% [23]. These may not be such important in developing countries in which life expectancy is rarely greater than 60 years.

A modeling study conducted in Nigeria showed that Screening and treatment for hypertension was potentially cost-effective with a wide range of uncertainty [29]. This is in line with other studies that screening for adults below age 40 years was not cost-effective. Another study conducted in Holland showed that, screening individuals above 60 years with; diabetes, previous CHD, familial CVD was cost-effective. It is not cost-effective to measure the BP of all patients, regardless of age, who visits the general practitioner [24]. This is in line with other studies that screening for adults below age 40 years is not cost-effective.

Study conducted in Kenya showed that home based screening for general population aged 35 years and older by using trained community health workers is cost-effective [26]. This because the program integrated community awareness creation with screening service.

Study conducted to evaluate health benefits and cost-effectiveness of asymptomatic screening for hypertension and high cholesterol in US showed that health impact is highest for hypertension screening and treatment (15,600 QALYs), but is closely followed by cholesterol screening and treatment (14,300 QALYs) [27]. Another study in the United States showed that screening adolescents for hypertension and treatment resulted in $48,500/QALY gained. Routine hypertension screening and treatment for adults 18 years and above is cost-effective was dominated by population-wide strategies such as salt reduction and increasing physical activity [28].

There is no enough evidence to recommend screening asymptomatic adults with no risk factors for hypertension. All studies form developed and developing countries revealed that screening adults aged 40 years with one or more risk factor is cost-effective [18-28]. This is in line with WHO PEN package interventions for primary health care in developing countries [34]. The recent Cochrane review on general health check also showed that Health checks have little or probably no effect on cardiovascular mortality, non-fatal ischemic heart disease and fatal and non-fatal stroke [35]. World health organization [12,34] recommends opportunistic screening for patients attending health facility for any reason for hypertension.

Universal Access to health care in developing countries is yet not ensured and health facility-based screening hypertension will not bear expected fruit in controlling the alarmingly rising disease and associated cardiovascular morbidity and mortality. This supported by rising prevalence of the disease and shift of the burden from developed to developing countries [36]. Out of an estimated 1.13 billion people worldwide living with hypertension, two-thirds are living in low and middle income countries and 80% of CVD related premature deaths are in also in low and middle-income countries [26,31,32,36,37].

It is important for developing countries to devise ways to increase opportunistic screening for adults aged 40 years and older to extent that all of these populations screened for hypertension periodically. It is also important to consider the associated change in demand for drugs and laboratory facilities to determine the extent screening to ensure the availability of recommended treatment for patients. We have handful of evidence that early initiation of non-pharmacologic and pharmacologic therapy of hypertension is cost-effective. Early initiation requires early detection of the disease. Incorporating adult screening programs with community awareness programs or providing set of integrated programs can improve hypertension management and control [12,31].

Limitations of the Study

The findings of this review should be considered in light of its limitations. The quality of pharmacoeconomic studies included was low. We included only articles published in English language. Articles published in other languages could have significant contribution in evidence synthesis.

Conclusion

There is no sufficient evidence to suggest general screening of adult populations for hypertension. Our review further strengthened the available evidence on opportunistic screening of adults aged 40 years and above with or without history of cardiovascular disease and diabetes for hypertension at least annually. Extending opportunistic screening of target population (i.e. population 40 years and above) to ensure universal screening, will yield good return on investment without casing significant change on health care budget for both developed and developing countries. Integrating screening services with other community services like education and counseling on salt reduction and physical activity will further improve cost-effectiveness of the program for developing countries. In addition to this developing countries should design strategies to increase access and availability essential medicines to address increased demand secondary to opportunistic screening. More strong economic evaluations from different perspectives are needed to recommend screening asymptomatic adults for hypertension.

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Availability of Data and Materials

Not Applicable. This is systematic review and we have used only published articles.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

All Authors read and approved the manuscript. MD has conceived the review project, framed the format design; MM has conducted the review and developed the manuscript for publication; SN participated in literature review and format design, participated in literature review and polished the language of the manuscript.

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