DOI: 10.7860/JCDR/2018/36400.12200

Original Article

Nursing Section

Prevalence of Childhood Hypertension in South Asia: A Systematic Review and Meta-Analysis

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ABSTRACT

Introduction: Hypertension is an emerging problem among children and adolescents in both developing and developed countries. Early diagnosis of hypertension is important to reduce the morbidity associated with it.

Aim: To estimate the prevalence of childhood hypertension in South Asian Region.

Materials and Methods: A comprehensive systematic literature search was conducted. PubMed-Medline, CINAHL, IndMED, and J-Gate databases were searched for original research articles published between 1980 and 2015. Study samples included children less than 18 years of age. Prevalence rate as set by each study was considered as outcome measure. We considered the articles published only in English language. For each electronic data base, search strategy specific to that database was developed. Two reviewers independently scrutinised the studies and reviewed data in a pre-tested proforma. Random effect model was used for meta-analysis.

Results: A total of 1322 titles were screened for eligibility of which 1234 titles were excluded as they were not relevant. Full text articles were obtained for 88 studies, of which 52 studies were found to have eligible data for the review and were included in the final synthesis.

Analysis of the data from 1,65,791 samples showed the overall prevalence of childhood pre-hypertension as 14.62% with 95% Confident Interval, CI (10.63-18.6%) and childhood hypertension as 5.54% with 95% CI (4.62-6.46%)

Conclusion: There is significant high prevalence of childhood hypertension, highlighting the need for public awareness interventions such as school health program, parents' education, screening of school children and adolescents for hypertension.

Keywords: Adolescent, Child, Cross-sectional studies, Paediatrics, Pre-hypertension

INTRODUCTION

High Blood Pressure (BP) is considered as one of the important risk factor for disease burden in South Asia [1]. Rising prevalence of hypertension in children is considered as one of the important health problem due to its long-term consequences during adulthood. This is becoming a major concern in high income countries as well as in developing countries. There is a need for early identification of children with hypertension, so that they may be placed under surveillance. The task force report on blood pressure (2004) recommends the incorporation of BP measurement among children above three years of age and adolescents during their routine examination [2]. The prevalence of hypertension is not rare in children compared to adults, which emphasises the need for routine evaluation of BP for both primary and secondary hypertension [3].

Studies have reported the higher prevalence of hypertension among obese compared to lean children [4-6]. As per the task force report (2004) pre-hypertension is defined as systolic or diastolic blood pressure above the 90th percentile but below the 95th percentile and hypertension is defined as systolic or diastolic blood pressure greater than the 95th percentile [2]. The lifestyle and dietary practices of children belonging to middle and high income group from developing countries has changed drastically as a consequence of socio-demographic transition [1]. These changes have led to the increased prevalence of non-communicable diseases such as obesity, hypertension among the children.

One time cross-sectional studies do provide a good outline and portrait of burden of hypertension; these studies do not give detailed insight into the patterns and dynamics of this growing problem. We could not trace any systematic review in South Asian region. Thus, a systematic review was designed to estimate the prevalence of pre-hypertension and hypertension among children less than 18 years in South Asian region.

The present review aims to systematically examine the available literature to consolidate the magnitude of childhood hypertension in South Asian region.

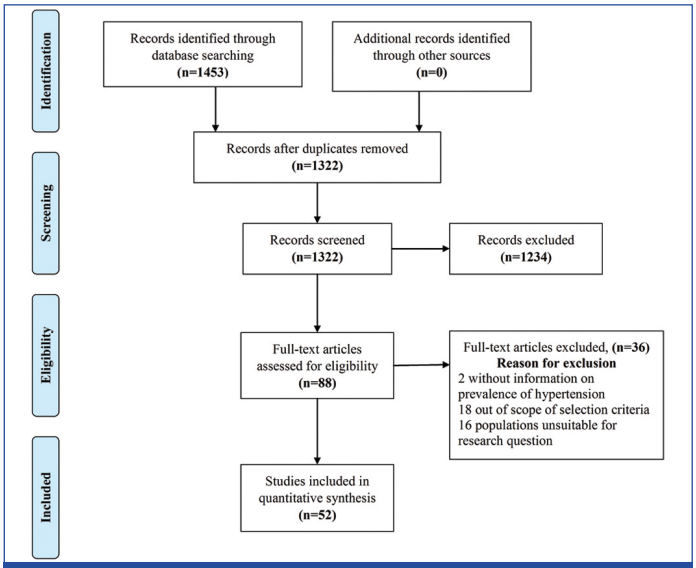
MATERIALS AND METHODS

Search methods for identification of studies: A comprehensive literature search for relevant original research studies published in English language between 1980 and 2015 was performed using PubMed–Medline, CINAHL, IndMED & J-Gate data bases. For each electronic data base, search strategy specific to that database was developed. The following keywords were used in the search: child, infant, young children, pre-school, adolescent, teenage, school children, youth, hypertension, high blood pressure, increased blood pressure, systolic pressure, diastolic pressure, prevalence, cross-sectional, descriptive, Asia, South Asia, India, Pakistan, Afghanistan, Bangladesh, Bhutan, Maldives, Nepal and Srilanka. The key and MeSH terms were nested using Boolean operator AND & OR.

Types of studies, participants, settings, measurements and outcome measure: In the review, we included cross-sectional, descriptive studies, observational, retrospective record review and case control studies. Available literature from all countries of South Asia was included in this review. Studies carried out among children less than 18 years irrespective of settings were included. We included the studies without any restriction on who measured the blood pressure. Prevalence rate based on the criteria set by each study and hypertension assessment criteria as defined by each study were used as such.

Selection of studies: We followed a three stage selection process for final inclusion of studies in the review. First stage, two reviewers independently assessed each title for its appropriateness for inclusion in the review. If both the reviewers independently agreed to reject a title then that title was rejected, and all other titles were moved to the second stage of selection. In the second

stage, abstract of first stage selected titles were obtained and two reviewers independently scanned all such abstracts. Here again, whenever both reviewers agreed to reject, such studies got rejected and remaining studies moved to the third stage of assessment. In third stage, full text article of all studies selected in the second stage were obtained and reviewed by two authors independently. If both reviewers agreed to accept then those studies got included, if both reviewers rejected then those studies got rejected as they did not meet the inclusion criteria. When there was disagreement, another reviewer was consulted and final decision on inclusion was taken. Final selection of studies is shown in [Table/Fig-1].



[Table/Fig-1]: PRISMA flow diagram of selection of studies.

Data extraction and management: Data was extracted using a pre-designed and pre-tested proforma. The proforma focused on extracting year of publication, authors, study setting, country, sampling method if any, sample size, prevalence, criteria used and age group. Data was extracted from full-text articles by one reviewer and was reviewed by a second reviewer. Disagreements if any were discussed with a third reviewer, and consensus was drawn.

STATISTICAL ANALYSIS

Data was analysed using statistical software StataDirect. Estimates of prevalence were assessed using random effect model. Results were expressed in terms of point prevalence, 95% confidence interval and forest plot.

RESULTS

All databases merged together, we obtained 1322 titles and were screened for eligibility, of which 1234 titles were excluded as they were not relevant. Full text articles were obtained for 88 studies, of which 52 studies were found to have eligible data for the review and were included in the final synthesis [Table/Fig-1]. Forty seven studies were conducted in India, two in Pakistan and one each from Nepal, Bangladesh and Sri Lanka. The age group of the children included in the study was less than 18 years.

Data were collected from 1,65,791 samples. Out of 52 included studies, only 41 studies mentioned the gender of the study population. Thus, in 41 studies there were 54,113 males and 42,825 females. The studies included for analysis of pre-hypertension were 17 [Table/Fig-2] and the population was 20,554. The studies included for prevalence of hypertension were 52 [Table/Fig-3-5] [6-59].

Analysis of the data showed the overall prevalence of childhood prehypertension was 14.62% with CI (10.63%-18.6%) [Table/Fig-6] and childhood hypertension was 5.54% with CI (4.62-6.46%) [Table/Fig-7].

Sl.No.	Author	Sample and Sample size	Setting	Research design	Prevalence
1	Rahman AJ et al., [6]	School children, 13-15 years, n=661.	Karachi, Pakistan	Cross sectional survey	15%
2	Amma GM et al., [7]	High school children, 13-17 years, n=1000.	Kerala, India	Cross sectional analytical study	24.50%
3	Amritanshu K et al., [8]	Children 5-19 years, n=2604.	Bihar, India	Hospital based Observational study	28.90%
4	Aroor AR et al., [9]	School children, 4-16 years, n=755.	Karnataka, India	Descriptive cross sectional study	1.9%
5	George GM et al., [10]	School children, 9-18 years, n=485.	New Delhi, India	Cross sectional survey	12.4%
6	Goel M et al., [11]	School children, 14-17 years, n=1221.	Madhya Pradesh, India	Prospective cross sectional observational study	6.45%
7	Gupta R et al., [12]	School children, 13-17 years, n=237.	Western India	Cross sectional	27.4%
8	Kar S et al., [13]	School children, 11-19 years, n=979.	Sikkim, India	Cross sectional	24.11%
9	Khopkari SA et al., [14]	Adolescents, 10-18 years, n=545.	Nasik, Maharashtra, India	Cross sectional observational survey	20%
10	Kishorkumar D et al., [15]	School children, 11-15 years, n=310.	Tamil Nadu, India	Cross sectional survey	14.2%
11	Kumar J et al., [16]	Adolescents, 10-19 years, n=990.	Wardha district, Maharashtra, Central India	Cross sectional survey	10.6%
12	Mahajan A et al., [17]	Primary, middle and senior secondary school, 10-19 years, n=3385.	Himachal Pradesh, India	Descriptive cross sectional study	22.3%
13	Narayanappa D et al., [18]	School children, 10-16 years, n=2000,	Karnataka, India	Cross sectional survey	2.8%
14	Patil RR et al., [19]	School children, 6-16 years, n=958.	Wardha District, Maharastra, India	Cross sectional survey	8.24%
15	Rao S et al., [20]	Children 9-16 years, n=2223.	Maharashtra, India	School based Cross sectional survey	10.84%
16	Saravanan M et al., [21]	Children 8-15 years, n=1143.	Gujarat, India	School based Cross sectional survey	9.4%
17	Sharma A et al., [22]	Children, 11-17 years n=1085	Shimla, India	School based Cross sectional survey	12.3%

[Table/Fig-2]: Description of studies included in assessment of Pre-hypertension [6-22].

DISCUSSION

The purpose of this review was to assess the prevalence of hypertension among children below 18 years of age in South Asia. The majority of the studies were conducted in India and five studies could be retrieved from other countries of South Asia. There were wide variations in the age range of the included population. In most of the studies the age group of the population was above four years. However, in one study [35], children in the age group of two months were included and in two studies [13,16], maximum age of the population was 19 years. Even though we aimed to review prevalence

Sl. No.	Author	Sample & Sample size	Setting	Research design	Prevalence
1.	Amritanshu K et al., [8]	Children 5-19 years, n=2604.	Bihar, India	Hospital based, Observational study	4.70%
2	George GM et al., [10]	School children, 9-18 years, n=485.	New Delhi, India	Cross sectional survey	8.2%
3	Goel M et al., [11]	School children, 14-17 years, n=1221.	Madhya Pradesh, India	Prospective cross sectional observational study	2.45%
4	Kar S et al., [13]	School children, 11-19 years, n=979.	Sikkim, India	Cross sectional	5.62%
5	Mahajan A et al., [17]	Primary, middle and senior secondary school, 10-19 years, n=3385.	Himachal Pradesh, India	Descriptive cross sectional study	11.3%
6	Saravanan M et al., [21]	School children, 8-15 years, n=1143.	Gujarat, India	Cross sectional survey	8.3%
7	Anand NK et al., [23]	School children, 5-17years, n=5000.	Punjab, India	Cross sectional study	0.46%
8	Bagudia S et al., [24]	School children, Stratified random sampling, 10-16 years, n=5,155.	Odissa, India	Cross sectional study	3.68%
9	Borah PK et al., [25]	School children, 5-14 years, n=10,003.	Assam, India	Descriptive, cross sectional study	7.60%
10	Buch N et al., [26]	School children, 6-18years, n=1249.	Gujarat, India	Prospective, cross sectional study	6.48%
11	Chadha SL et al., [27]	School children, 5-14years, n=10,215.	New Delhi, India	Epidemiological study	11.68%
12	Chahar CK et al., [28]	School children, 4-9 years n=500,	Rajasthan, India	Preliminary report	1.39%
13	Chirag BA et al., [29]	School children, 5-15 years, n=983.	Gujarat, India	Prospective cross sectional study	3.19%
14	De AK et al., [30]	School children, 5-15years, n=9661.	West Bengal, India	Prospective cross sectional study	0.38%
15	Durrani AM et al., [31]	School children, 12-16 years, n=701.	Uttar Pradesh, India	Cross sectional study	9.40%
16	Genoves S et al., [32]	School children, 5-12 years, n=1176.	West Bengal, India	Not mentioned	5.20%
17	Gupta AK et al., [33]	School children, 5-15 years, n=3861.	Aligarh, North India	Not mentioned	0.16%
18	Gupta GK et al., [34]	Adolescents, 11-18 years, n=1340,	Uttar Pradesh, India	Community based Cross sectional	5.30%
19	Hari P et al., [35]	Children, 2 months to 16 years, n=21,980.	North India	Retrospective record review	1.10%
20	Kajale NA et al., [36]	School children, 6-18years, n=6380.	North India	Cross sectional survey	5.60%
21	Kapil U et al., [37]	School children, 5-16 years, n=9420,	Delhi, India	Cross sectional survey	3.40%
22	Laroia D et al., [38]	School children, 5-14 years, n=2073.	North India.	Not mentioned	2.93%
23	Mangal N et al., [39]	School children, 1-12 years, n=1500,	Rajasthan, India	Not mentioned	5.83%
24	Mohan B et al., [40]	School children, 11-17 years, n=3326.	Punjab, India.	Cross sectional survey	5.68%
25	Saha I et al., [41]	Adolescents,10-19 years, n=1081,	West Bengal, India	Cross sectional study	0.02%
26	Sharma A et al., [22]	School children, 11-17 years, n=1085.	Shimla, India	Cross sectional survey	5.90%
27	Singh AK et al., [42]	School based, 12-18 years, n=510.	New Delhi, India	Cross sectional survey	7.84%
28	Verma M et al., [43]	School children, 5-15 years, n=2560	Punjab, India.	Cross sectional survey	2.80%

[Table/Fig-3]: Description of studies conducted in North India & included in assessment of hypertension [8,10,11,13,17,21,23-43].

Sl. No.	Author	Sample & Sample size	Setting	Research design	Prevalence
1	Amma GM et al., [7]	High school children,13-17 years, n=1000.	Kerala, India	Cross sectional analytical study	0.6%
2	Aroor AR et al., [9]	School children, 4-16 years, n=755,	Karnataka, India	Descriptive cross sectional study	0.8%
3	Gupta R et al., [12]	School children, 13-17 years, n=237	Western India	Not mentioned	7.20%
4	Kishorkumar D et al., [15]	School children, 11-15 years, n=310,	Tamil Nadu, India	Cross sectional survey	10.0%
5	Kumar JD et al., [16]	Community, 10-19 years, n=990	Maharashtra, India	Cross sectional survey	3.40%
6	Narayanappa D et al., [18]	School Children, 10-16 years, n=2000,	Karnataka, India	Cross sectional survey	2.40%
7	Patil R et al., [19]	School, 6-16 years, n=958,	Maharashtra, India	Cross sectional survey	3.00%
8	Taksande A et al., [44]	School children, 6-17 years, n=2643,	Maharashtra, India	Prospective cross sectional survey	5.75%
9	Jagadesan S et al., [45]	School children and adolescents, 6-17 years, n=18,955,	Tamil Nadu, India	Cross sectional survey	25.60%
10	Kamath VG et al., [46]	School children, 5-16 years, n=2067	Karnataka, India	Cross sectional survey	2.2%
11	Kanagarajan P et al., [47]	School children, 11-15 yrs, n=405,	Tamil Nadu, India	Cross sectional survey	8.60%
12	Lone DK et al., [48]	School children, 12-16 years, n=450,	Maharashtra, India.	Cross sectional study	11.77%
13	Ramanathan ASK et al., [49]	School children, 10-17 years, n=3906,.	Tamil Nadu, India	Cross sectional study	9.50%
14	Reddy MD et al., [50]	School children, 6-15 years, n=522,	Maharashtra, India	Cross sectional study	4.40%
15	Savitha MR et al., [51]	School children, 10-16 years, n=503,	Karnataka, India	Cross sectional survey	6.16%
16	Sayeemuddin M et al., [52]	School children 6-16 years, n=3302,	Hyderabad, India	Prospective observational study	2.42%
17	Singhal V et al., [53]	Female adolescents 12-17 years, n=200,	Karnataka, India	Case control study	11.0%
18	Soudarssanane MB et al., [54]	Adolescents, 15-19 years, n=673,	Tamil Nadu, India	Case control study	8.5%
19	Sundar JS et al., [55]	School children, 13-17 years, n=400,	Tamil Nadu, India	Cross sectional survey	21.50%

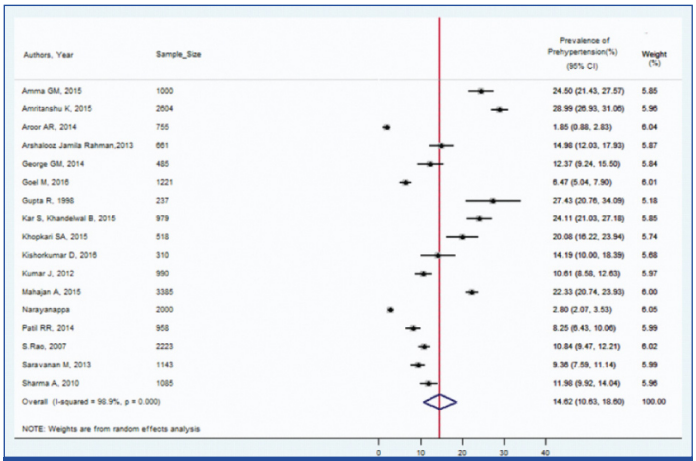
[Table/Fig-4]: Description of studies conducted in South India and included in assessment of hypertension [7,9,12,15,16,18,19,44-55].

among children less than 18 years, we did not exclude these two studies which reported prevalence among children of 10-19 years.

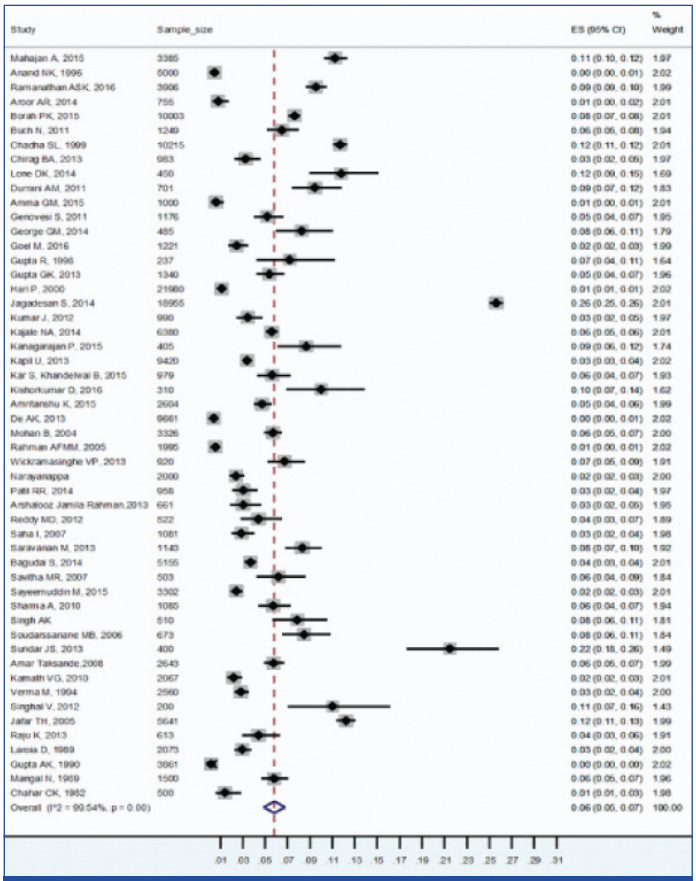
Measuring blood pressure among children was done either in school, hospital or community however, in most of the studies

Sl. No.	Author	Population, sampling technique and setting	Setting	Research design	Prevalence
1	Rahman AJ et al., [6]	School children, 13-15years, n=661,	Karachi, Pakistan	Cross sectional survey	3%
2	Jafar TH et al., [56]	Community, 5-14 years, n=5641.	Pakistan	Cross sectional survey	12.2%
3	Raju K et al., [57]	School children, 10-16 years, n=613,	Kathmandu, Nepal	Cross sectional survey	4.40%
4	Wickramasinghe VP et al., [58]	School children, 5-15 years, n=920.	Colombo, Srilanka	Cross sectional descriptive survey	6.70%
5	Rahman AM et al., [59]	School children, 6-16 years, n=1995	Dhaka, Bangladesh	Cross sectional descriptive survey	0.55%

[Table/Fig-5]: Description of studies conducted in other countries of South Asia other than India and included in assessment of hypertension [6,56-59].



[Table/Fig-6]: Forest plot showing prevalence of pre-hypertension (17 studies).



[Table/Fig-7]: Forest plot showing prevalence of hypertension (52 studies).

blood pressure measurement was done in school. Majority of the studies were cross-sectional survey except two were case control [53,54], one retrospective record review [35] and two were observational studies of which one was hospital-based observational study [8] and other one was a prospective observational study [52]. In five studies [12,32,33,38,39] design was not specified; one study was reported as preliminary report [28] and one as epidemiological study [27]. There is variation in the norms used by the different studies. Task force report (2004) was commonly used. American Heart Association norms, IDF criteria study, Seventh Report of Joint National Committee on prevention, detection, Evaluation and treatment of High blood pressure (2003) & WHO criteria for hypertension for 10-18 years were the other norms used by the authors to define hypertension and pre-hypertension.

Regarding location of the study, 19 studies were carried out in urban area, eight were in rural area; five studies were conducted both in urban and rural area and one study in sub-urban area. However, in 19, studies location was not mentioned. In the present review the maximum sample size was reported in the hospital-based retrospective review [35] and in the school set up maximum sample size was 18,955 [45] and minimum was 237 [12].

We found that there was high degree of heterogeneity in the reported prevalence of childhood hypertension in the reviewed studies. The prevalence of pre-hypertension was highest (28.9%) in Bihar [8] where as it was reported minimum (1.9%) in Karnataka [9]. High prevalence of hypertension was reported in Tamil Nadu [45] with 25.60% and that of lowest in West Bengal [41] with 0.02%. The prevalence of pre-hypertension and hypertension was 15% & 3% respectively in Pakistan [6] which is almost similar to Indian study findings. In other countries of South Asia reported prevalence was comparatively low [Table/Fig-6] [57-59].

Hypertension among children has got many precipitating or aggravating factors. Family history and obesity were the most common. Several studies reported cardiovascular risk factors and life style associated risk factors among adolescents [Table/Fig-7] [8,17,22,57].

LIMITATION

The main limitation of this review is that we could retrieve two studies from Pakistan, one from Nepal, one from Sri Lanka, one from Bangladesh and majority of the studies were from India. We were unable to retrieve the studies from other countries of South Asia. This could limit the generalisability of the study findings.

In majority of studies BP was measured thrice (three readings) in the same visit. In some studies to confirm the prevalence of hypertension, a second set of BP measurements were taken after four weeks. Differences in BP measurement methods are expected which may account for variations. That could also be one of the limitations of the present review. The variables that may influence of covariate on hypertension such as family history, lifestyle factors, body mass index, birth weight were not included in the present review.

Majority of the studies included in the review are cross-sectional studies which are observational by nature. Because of this reason, in a systematic review of cross-sectional studies inevitably there will be presence of considerable amount of methodological heterogeneity as there will be differences in the method of conduct of different studies which results in statistical heterogeneity (variability in the effect sizes). This could be another limitations of the present review.

CONCLUSION

The findings of the study suggest that prevalence of childhood hypertension is significantly high in South Asian region. There is a need for public awareness interventions on healthy lifestyle for

children and their parents. Further research is required to determine the accurate prevalence and the risk factors involved in other countries of South Asia.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 13, 2018**
Date of Peer Review: **May 04, 2018**
Date of Acceptance: **Jul 03, 2018**
Date of Publishing: **Oct 01, 2018**