Original Article

Hypertension as a silent epidemic among late adolescent girls, its associated demographic factors, and pregnancy outcome: A report from national family health survey (NFHS) IV data

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Abstract

Background: Hypertension is predominantly considered to be a disease frequently occurring after the fifth decade of life, its occurrence among adolescents has not received much public health attention. Pathophysiological and epidemiological evidence suggests that essential hypertension initiate in childhood and often goes unnoticed unless explicitly observed for this age group. **Aim:** The current study estimates the prevalence of hypertension, its predictors, and pregnancy outcome among late adolescent girls (15–19 years). **Material and Methods:** The study used secondary data from the NFHS 4 from January 2015 to December 2016. The sample of 1,24,878 adolescent girls out of 6,99,686, national women's data was obtained through a stratified two-stage sample using a population proportionate to size sampling methodology. Descriptive statistical tests and inferential statistics were performed to find the relation of hypertension with the independent variables and Chi-square analysis to study association of hypertension during pregnancy and its adverse pregnancy outcomes. **Results:** The prevalence of hypertension among the late adolescents was 16.4% [CI: 16.2-16.6] (n=20,532). On multivariable logistic regression (after adjusting for all the variables) only age [AOR: 1.09 (1.08-1.11)]; education [AOR: 1.09 (1.006 – 1.2)], and wealth index [AOR: 1.17 (1.11 – 1.24)] retained the significance with hypertension. A significant association was seen between hypertension status of the adolescents and adverse pregnancy outcomes ($\chi^2 = 4.550$, $P = 0.033$). **Conclusion:** Nearly 1/6th of late adolescents found to be hypertensive, significantly contribution to disease burden. Also, a significant association is seen between hypertension status of adolescents and adverse pregnancy outcomes. Hence, it is imperative to make the National Programme inclusive for adolescents and have a focused approach to health promotion, prevention, and management of non-communicable diseases.

Keywords: Hypertension, India, late-adolescents, NFHS-4, pregnancy outcomes

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Introduction

Hypertension considered to be a disease of adults has its roots in childhood, which is a significant risk factor for cardiovascular diseases (CVDs), and stroke.[1] Worldwide hypertension is a silent

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threat to the health of people[2] with its prevalence increasing to more than 25% worldwide between 2000 and 2010.[3] Global age-standardized prevalence of hypertension among adults was 32% among women and 34% among men in 2019.[4] In India, the prevalence of hypertension among 15 to 49 years, according to various studies, was 11.3% to 15%.[5-7] The most common risk factors for hypertension as revealed by these studies include male gender, living in an urban area, urbanization, sedentary lifestyle, obesity, stress, unhealthy habits such as smoking, alcohol consumption, changes in dietary habits, etc.[5-8]

Hypertension and CVDs are mainly considered to be the diseases most commonly occurring after the fifth decade of life, while in adolescents, it has received limited public health attention. The epidemiological and physiological evidence suggests that essential hypertension and the risk factors of cardiovascular diseases have their origin in childhood which goes undetected unless specifically looked for during this age group.[9] Adolescents (adolescence: a period of transition between childhood to adulthood) make their lifestyle choices which will continue throughout their adulthood and old age. These lifestyle choices are primarily influenced by acculturation and globalization.[10] Unfortunately, many of the unhealthy lifestyle choices adopted by adolescents are a threat to their health, like tobacco use, consumption of junk food, and low levels of physical activity predisposing them to obesity, hypertension, and dyslipidemia.[10]

The prevalence of hypertension among adolescent girls in India varies from 2% to 20.5%.[3,11-16] The risk factors for hypertension among adolescent girls and adults were found to be similar. Overweight and obesity, less physical activity, family history of hypertension, habits (alcohol, tobacco, and betel nut consumption), stress, high salt intake, and junk food consumption were the common risk factors. Also, childhood blood pressure (BP) a strong indicator of adult BP, was reported in various studies.[17-19] So, early detection of hypertension and its related factors is vital so that future burden and complications of hypertension can be prevented.[9] Added to this is the burden of early marriage, teenage pregnancy in many developing countries, including India, which further makes the issue complicated, with the impact of morbidity of the disease not only affecting the individual but also the pregnancy outcome and hence the offspring. In this background, this secondary analysis of nationally representative National Family Health Survey IV (NFHS 1V) data, was planned to estimate the prevalence of hypertension along with estimating its predictors and pregnancy outcome among late adolescent girls (15–19 years).

Methodology

Data source: The fourth round of the National Family Health Survey (NFHS-4) conducted in the year 2015–2916 provides data of Indian states and union territory on its population health and nutrition. International Institute for Population Sciences (IIPS), Mumbai, is the designated nodal agency under the Ministry of Health and Family Welfare (MoHFW) and has conducted all four rounds of the survey so far.[20]

Sample size and techniques

The NFHS-4 utilizes a stratified two-stage sampling procedure with a population proportionate to size (PPS) sampling technique. In the first stage, the selection of primary sampling units (PSUs) was made through the 2011 census, which served as the sampling frame. Selected PSUs were further divided into segments of approximately 100–150 houses from out of which two were chosen randomly for the survey using systematic sampling with probability proportional to segment size.

Thereafter a complete house-to-house mapping and line listing operation were conducted in selected rural and urban PSU. In the second stage, through systematic sampling, 22 households were randomly selected within the cluster. Data collection was conducted from 20 January 2015 to 4 December 2016.[20]

Study variables: The data of about 6,99,686 women were available for the analysis, out of which we conducted a secondary analysis from Woman's Questionnaire specific to late adolescents, that is, 15–19 years, who were 1,24,878 in number [Figure 1]. In them the data related to religion, marital status, geographical distribution, socioeconomic status, education, tobacco, and alcohol history, morbidity history (diabetes, asthma, thyroid disorders, etc.,), history of pregnancy complications, pregnancy outcomes (abortions, miscarriage, stillbirths, and other morbidities),[20] anthropometry (Height, Weight, Body mass index (BMI)) and BP were retrieved and analyzed. In the survey, trained professionals used a digital BP monitor for recording three systolic and diastolic readings at 5 min intervals, and the mean of all the readings was taken as a final. BP was considered high when the mean of the three readings of BP was >130/80 mmHg for 15–18 years (as per American Paediatric Association guidelines)[21] and >140/90 mmHg for 19 years (as per JNC 8 criteria).[22]

Data Analysis: The data were analyzed using SPSS V.25 (Licenced to JSS AHER). Descriptive statistics like mean, standard deviation, frequencies were used, and relevant data were represented in the form of tables and graphs. Univariable and multivariable logistic regression analyses were done to predict the relation of hypertension with sociodemographic variables and other relevant risk factors. Results of univariable and multivariable logistic regression were represented as a crude and adjusted odds ratio. The variables which were significantly associated with hypertension on univariable analysis were included in the multivariable logistic regression model. Chi-square analysis was performed to find the association between hypertension during pregnancy in this age group and adverse pregnancy outcomes (miscarriage, stillbirth, or abortion). The confidence level was considered at 95%, and the alfa level was 5%.

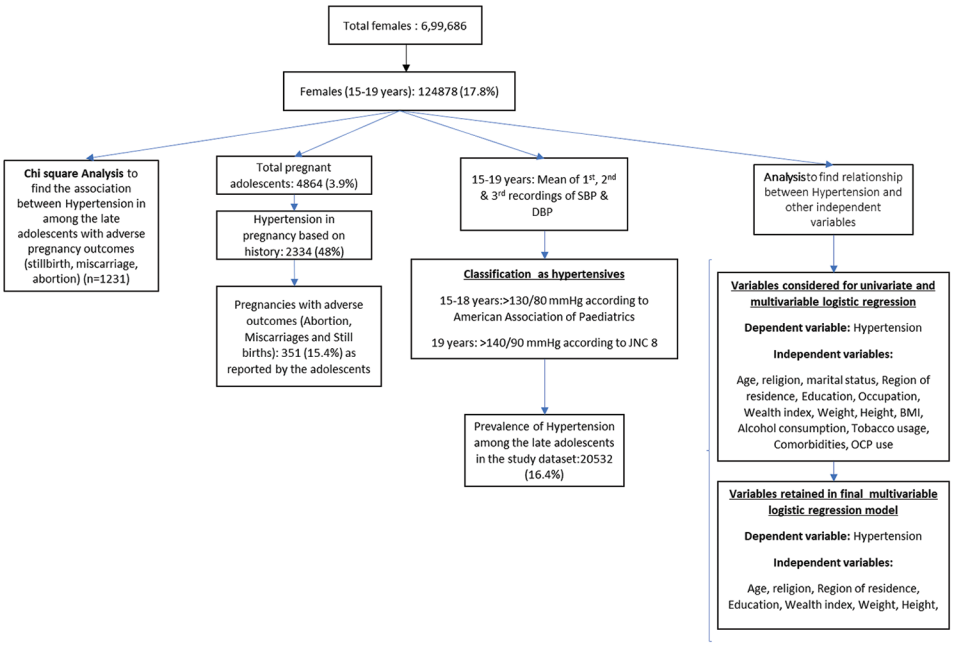

Figure 1: Methodology and conduct of analysis from NFHS data. Note: SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

Ethical consideration

It is a secondary data analysis for which permission has been already granted by the Institute's Ethical Committee, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh (PGI/IEC/2019/002357). No relevant guidelines and regulations are needed in the study.

Results

Out of the total 6,99,686 women interviewed, data from 1,24,878 (constituting 17.8%) late-adolescent girls (15–19 years) were included for analysis. Among them, the mean age was 16.96 ± 1.39 years. The majority of the data represented was from Uttar Pradesh (17.8%) followed by Madhya Pradesh (9.4%) and Bihar (8.1%), and minimum representation was from Chandigarh, Dadra and Nager Haveli, and Lakshadweep Islands, with each Union territory representing 0.1% [Figure 2]. Other characteristics concerning the adolescents are mentioned in Table 1. As per age-recommended cut-offs, 16.4% [CI: 16.2-16.6] of the adolescent girls were found to be hypertensives. [Figure 3]

On conducting univariable analysis age, place of residence, region of residence, religion, marital status, comorbidities, BMI, education, wealth index, alcohol consumption, consumption of tobacco (khaini), having used oral pills for contraception showed statistically significant relation with hypertension.

In multiple logistic regression, after adjusting for all the variables, age, religion, geographical distribution, education, and wealth index retained the statistical significance. [Table 2] Every unit increase in age showed 1.09 times odds for getting affected by hypertension which was found to be statistically significant ($p < 0.001$). Adolescents belonging to other religions like Sikhism, Buddhism, Jainism, Jewish, Parsi/Zoroastrian, etc., showed lesser odds [AOR: 0.906 (0.904–0.996)] compared to Hindu's for getting affected by hypertension in univariable analysis, but in multivariable logistic regression analysis, it showed protective effect [AOR: 0.906 (0.904–0.996)] which was statistically significant ($p = 0.041$). Those living in the eastern region had 2.5 times the odds [AOR: 2.51 (2.31-2.71)] of getting affected by hypertension in comparison with the northern region, followed by other regions, which were found to be statistically significant in multivariable logistic regression ($p < 0.001$). Concerning education, compared to adolescents with no education, those who had completed primary [AOR: 1.09 (1.006–1.2)] or middle school education had higher odds of them being hypertensives and was found to be statistically significant in both univariable and multivariable logistic regression analysis ($p = 0.037$ for primary school). Those belonging to a higher order of wealth index, that is, poorer [AOR: 1.17 (1.11–1.24)] and middle [AOR: 1.06 (1.01–1.120)] in comparison to the poorest, had higher odds of becoming hypertensives, and both were found to be statistically significant in multivariable logistic regression ($p < 0.001$, $P = 0.013$). The people living in the urban area showed a statistically significant protective effect against hypertension in the univariable analysis though it did not retain significance in the multivariable logistic regression analysis [Table 2].

A history of pregnancy was reported by 3.9% of the adolescents. Among them, various pregnancy-related complications as reported by the adolescents are mentioned in Table 3. 48% among them reported hypertension during pregnancy. However, there was a significant statistical association seen between hypertension and adverse pregnancy outcomes (stillbirth, miscarriage or

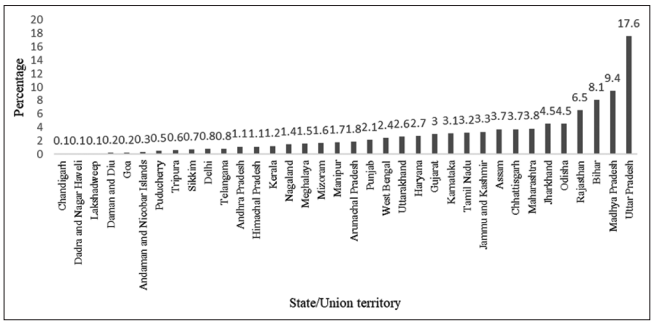

Figure 2: Distribution of the adolescent girls based on the State/Union Territory of residence

abortion) ((χ^2 = 4.550, *P* = 0.033), [Table 4] though many of them did not report hypertension detected during pregnancy and were detected to be hypertensives in our analysis (based on average of three BP readings as obtained by the NFHS IV data).

Discussion

In the current study, the hypertension prevalence among late adolescents was found to be 16.4%. Several studies including Goswami T *et al.*[3] conducted among school-going children between 13 and 15 years showed the prevalence of 12%, studies by Mohan B *et al.*[11] conducted among children between 11 and 17 years showed the prevalence of 5.7% in rural and 8.4% in urban areas, the study by Kumar P *et al.*[12] conducted among early adolescents (13–15 yrs) showed a prevalence of 4.6%, the study by Sundar JS *et al.*[13] conducted among children between 13 and 17 years of age showed the prevalence of 21.5%, the study by Patel U *et al.*[14] showed the prevalence of 8% among children between 11 and 17 years and the study by Patel *et al.*[15] has shown a prevalence of 7% among children between 5 and 15 years of age. A systematic review conducted by Daniel *et al.*[16] showed a prevalence between 2% to 20.5%. These differences in the prevalence could be due to the variation in the age groups of children and adolescents participating in these studies, the difference in the scale used for categorization of hypertension, and the variation in the geographical area where these studies were conducted. Ours being the secondary data analysis of NFHS IV data of late adolescence, the prevalence might be higher as hypertension might have become more apparent among late adolescents compared to earlier ages. NFHS IV data having a better representation of the country compared to the other studies would serve as a better indicator of hypertension in this age group.

In the analysis, it was found that age, religion, geographical distribution, education, and wealth index were significantly related with hypertension among adolescents. The difference in religion and geographical distribution could be due to cultural and social differences. Concerning education, it was seen that better education was found to be protective reason. However, with respect to age, with every unit increase in age, the odds of hypertension also increased. This could be due to the added stress and responsibilities with an increase in age. For the wealth index, though the odds of getting affected with hypertension increased among those belonging to the poorer and middle category in comparison to the poorest, the odds reduced for those who belonged to richer and richest. The possible reason could be that with higher categories of wealth index, there are mostly better

Table 1: Characteristics of late adolescents (15-19 years) of NFHS IV dataset

Variable	Percentage
Religion	
Hindu	73.3
Muslim	15.9
Christian	6.8
Others (Sikh, Buddhist, Jain, Jew, Parsi, Zoroastrian, etc.)	2.9
Current Marital status	
Never Married	86.3
Married	13.7
Area of residence	
Urban	26.6
Rural	73.4
Education	
No education	7.1
Primary	7.3
Secondary	80.2
Higher	5.5
Engaged in any occupation	
Yes	17.4
No	82.6
Wealth Index	
Poorest	21.3
Poorer	24.1
Middle	21.8
Richer	18.3
Richest	14.4
Body Mass Index (*n*=122225)	
Moderate to Severe thin	16.5
Mild thin	21.5
Normal	56.1
Overweight	3.2
Obese	0.6
Alcohol Consumption	
Yes	99
No	1
Diabetic	
No	98.5
Yes	0.3
Don't know	1.2
Asthma	
No	98.7
Yes	0.8
Don't know	0.4
Thyroid	
No	98.9
Yes	0.6
Don't know	0.5
Cardiovascular problems	
No	98.9
Yes	0.6
Don't know	0.5
Cancer	
No	99.5
Yes	0.1
Don't know	0.4

Table 2: Univariable and multiple logistic regression to determine the association between risk factors and hypertension

Variable	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age	1.105 (1.093-1.117)	<0.001	1.09 (1.08-1.11)	<0.001
Current age				
Religion		<0.001		<0.001
Hindu	1			
Muslim	0.816 (0.758-0.879)	<0.001	0.963 (0.891-1.04)	0.336
Christian	0.975 (0.900-1.057)	0.544	1.10 (0.998-1.17)	0.057
Others	1.129 (1.033-1.234)	0.008	0.906 (0.904-0.996)	0.041
Marital Status		<0.001		
Never married	1			
Married	0.857 (0.822-0.894)	<0.001		
Education	-	<0.001		<0.001
No education	1			
Primary	1.186 (1.093-1.288)	<0.001	1.09 (1.00-1.20)	0.037
Secondary	1.120 (1.031-1.216)	0.007	1.02 (0.993-1.12)	0.569
Higher	0.925 (0.866-0.987)	0.019	0.952 (0.88-1.02)	0.172
Occupation				
No	1			
Yes	0.980 (0.893-1.077)	0.677		
Place of Residence		<0.001		
Urban	1			
Rural	0.864 (0.835-0.895)	<0.001		
Geographical distribution		<0.001		<0.001
Northern region	1			
North-east region	1.878 (1.756-2.009)	<0.001	1.85 (1.73-1.99)	<0.001
Eastern region	2.615 (2.442-2.800)	<0.001	2.51 (2.31-2.71)	<0.001
Western region	1.377 (1.287-1.473)	<0.001	1.25 (1.16-1.34)	<0.001
Central region	1.251 (1.151-1.361)	<0.001	1.24 (1.14,1.35)	<0.001
Southern region	1.752 (1.645-1.865)	<0.001	1.65 (1.55-1.76)	<0.001
Wealth Index		<0.001		<0.001
Poorest	1			
Poorer	1.138 (1.082-1.198)	<0.001	1.17 (1.11-1.24)	<0.001
Middle	1.101 (1.048-1.158)	<0.001	1.06 (1.01-1.12)	0.013
Richer	0.988 (0.938-1.041)	0.653	0.989 (0.93-1.04)	0.689
Richest	0.985 (0.933-1.039)	0.574	1.00 (1.00-1.06)	0.904
BMI		<0.001		
Moderate to severe thin	1	<0.001		
Mild Thin	0.246 (0.212-0.286)	<0.001		
Normal	0.259 (0.244-0.300)	<0.001		
Overweight	0.359 (0.311-0.415)	<0.001		
Obese	0.685 (0.584-0.802)	<0.001		
Alcohol Use	0.683 (0.597-0.782)	<0.001		
Tobacco usage				
Bidis	1.811 (0.719-4.557)	0.207		
Hookah	1.653 (0.654-4.179)	0.288		
Khaini	0.860 (0.672-1.100)	0.230		
Comorbidities	0.893 (0.805-0.990)	0.032		

opportunities for a healthy lifestyle, and access to better health facilities.[19] This finding is contrary to the findings of Mohan *et al.*[11] study, which showed that upper socioeconomic status was established to be a risk factor for hypertension.

Contrary to the findings in many studies that overweight and obesity, tobacco and alcohol consumption, comorbidities are the important predictors of hypertension[3,11-14] our analysis did not find any such relationship. This finding seems to point out that there might be completely different pathophysiology underlying hypertension in this age group unlike the adults, which requires further research.

Out of the 3.9% adolescents, who were pregnant, 48% reported hypertension. Several studies conducted in various parts of the world have shown a prevalence between 5.5% and 20%.[20,23] In India, while studies specific to the prevalence of hypertension among late pregnant adolescents could not be

Table 3: Various pregnancy-related complications as reported by late adolescents

Variable	Percentage (*n*=4864, 3.9% of adolescents who experienced pregnancy)
Vaginal bleeding	
Yes	43.5
No	56.7
Convulsions	
Yes	41
No	59
Prolonged labor	
Yes	48.7
No	51.3
Abdominal pain	
Yes	51.2
No	48.8
Hypertension	
Yes	48
No	52
Adverse pregnancy outcomes (stillbirths, miscarriage, abortions)	
Yes	15.4
No	84.6

Table 4: Association between adverse pregnancy outcomes and pregnancy hypertension

Variables	Hypertension		χ^2 test	*P*
	Absent	Present		
Pregnancy outcomes: Abortion, Miscarriage, Stillbirth				
No	103345 (99%)	20302 (98.8%)	χ^2=4.550	0.033
Yes	1001 (1%)	230 (1.2%)		
Total (*n*=1,24,878)	104346	20532		

found, the prevalence of hypertension, in general, is reported to be between 7% and 10%.[21,22] This huge difference between the prevalence that is seen in NFHS data in comparison to other studies could be for the reason that this data is based on the history and not the real-time measurement of BP recordings.

In the current study, it was also found that there was significant association between hypertension and adverse pregnancy outcomes. This finding is similar to the study by Parra-Pingel *et al.*[24] and the study by La-Orpipat *et al.*,[25] where it was seen that the hypertensive adolescents had significantly higher rates of maternal death, maternal heart disease, Pregnancy induced hypertension (PIH), puerperal infection, chorioamnionitis, urinary tract infection, fetal anomaly, preterm delivery, low birth weight, low Apgar scores, and stillbirth. Multivariable logistic regression analysis showed that both older (16–19 years old) and younger (≤15 years old) adolescents were significantly at an increased risk of PIH. The increased risk of adverse pregnancy outcomes and hypertension is likely to be due to impaired placental perfusion and function.[26,27]

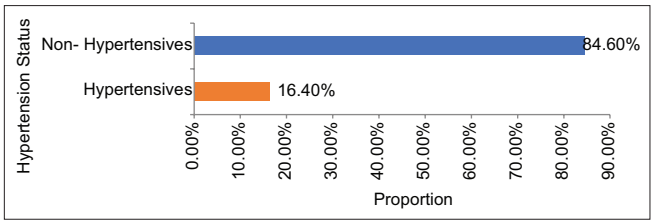

Figure 3: Proportion of late adolescent girls with hypertension

The main strength of the study is that it is a secondary data analysis of a nationally representative data with very few studies focusing on hypertension among younger age groups. Hence, these data would serve as baseline data for future research. However, since it is a secondary data analysis, we were not able to find the temporal association between some important variables that could be of interest concerning hypertension like family history, stress scores, etc., Also, to mention is that most of the data related to risk factors in the survey were collected through a questionnaire, which could have led to recall bias influencing the results. The proportion of adolescents who smoked tobacco and consumed alcohol was meagre (0.1%) compared to the other group, and this might have led to biased results. Hence, we recommend that further studies involving a representative population of both groups should be conducted.

Conclusion and Recommendations

With 16.3% of late adolescents found to be hypertensive in this secondary data analysis, a considerable proportion of burden of hypertension seems to be contributed by them. Also, there has been a significant association seen between hypertension and adverse pregnancy outcomes in this age group, who are going to be future mothers. With the National program for Non-Communicable Diseases (National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke) already functioning in India, there is a need to make the program inclusive for younger age groups and focus on the promotion of early intervention like screening and promoting a positive lifestyle.[28-30]

List of abbreviations

NFHS IV = National Family Health Survey IV

IIPS = International Institute of Population Sciences

MoHFW = Ministry of Health and Family Welfare

PSU = Primary Sampling Unit

OCP's = Oral Contraceptive Pills

CI = Confidence Interval

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Conflicts of interest

There are no conflicts of interest.

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