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Prevalence, pattern & correlates of hypertension among tribal population of Kashmir, India: A cross-sectional study

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***Background & objectives*: The prevalence of hypertension is increasing among all ethnic groups across the globe with only a handful of studies from India addressing the prevalence of hypertension among tribal population. In view of paucity of data, this study was aimed at estimating the prevalence of hypertension and associated risk factors among tribal population of Kashmir, India.**

***Methods*: This cross-sectional survey included 6808 tribals aged >20 yr (5695 *Gujjars* and 1113 *Bakarwals*) from five randomly selected districts of Kashmir. Modified WHO-STEPS surveillance questionnaire was used to collect relevant data. Hypertension was defined by Joint National Committee on Prevention, Detection, Evaluation and Treatment of Hypertension (JNC 8) criteria.**

***Results*: The mean age of our study participants was 43.12 ± 15.69 years. Overall prevalence of hypertension [95% confidence interval (CI)] was 41.4% (39.9-42.9%) [men=46.7% (44.1-49.1%); women=37.9% (35.9-39.9%)]. The prevalence of prehypertension (95% CI) in our study was 35 per cent (33.7-36.6%). Higher age [adjusted odds ratio (OR) (95% CI): >70 yr-2.2 (1.9-2.4)], passive smoking [OR-1.3 (1.1-1.5)], family history of hypertension [OR-1.6 (1.4-1.7)] and obesity [OR-1.3 (1.1-1.6)] were significantly associated with hypertension. A weak positive correlation was observed between BP (systolic/diastolic) with haemoglobin, red blood cell count and haematocrit (P<0.05).**

***Interpretation & conclusions*: *Gujjar* and *Bakarwal* tribes of Jammu and Kashmir showed high prevalence of hypertension. Hence, urgent policies and reforms are needed to tackle this silent epidemic and further studies focusing on community-based interventions are required.**

Key words Age - hypertension - Kashmir - prevalence - tribal population

Hypertension, a major modifiable metabolic risk factor for CVD was ranked as the leading cause of global burden of diseases in 2010 with four million deaths and seven per cent disability-adjusted life years (DALYs) lost worldwide due to its complications[1].In India, hypertension [high

systolic blood pressure (BP)] has been identified as one of the five major risk factors contributing to DALYs with an increase in the prevalence from 1990 to 2016[2]. Since high BP hardly produces any symptoms, diagnosis of hypertension largely relies on screening programmes and incidental detection. Epidemiological studies in the last decade have reported varying prevalence of hypertension ranging from 17 to 47 per cent from different parts of India[3-5] and a systematic review of epidemiological studies found overall prevalence of hypertension as 29.8 per cent with a significant urban–rural difference[4]. A large nationwide study (ICMR-INDIAB study) also reported the prevalence of hypertension as 26.3 per cent[5].

In India, tribal population accounts for 104.3 million constituting 8.6 per cent of the total population as per 2011 census[6]. Epidemiological studies of hypertension among Indian tribes have been far and few. A meta-analysis of prevalence of hypertension in Indian tribes, which included around 20 studies published over three decades (1981-2011) showed the prevalence of only 16.1 per cent but with a significant increasing trend in prevalence with each passing decade[7]. This study also noted lower prevalence of hypertension among tribes from Himalayan and northeastern region as compared to other regions which was attributed to chronic hypoxic stress due to residence at higher altitude, leading to vasodilation and consequent fall in BP[7].

Only a couple of studies have reported prevalence of hypertension from Kashmir valley, and these were mostly conducted on small samples[8,9]. However, there is no information on the prevalence of hypertension among tribal subjects of Kashmir who are quite unique compared to tribes from other parts of India because they live at high altitude and face prolonged and harsh winter season that lasts for almost half of the year. Their food and lifestyle habits are also different from other parts of the country. This study was aimed at estimating the prevalence of hypertension and its correlates among the indigenous tribal population of Kashmir across different districts of the valley. In addition, the prevalence of pre-hypertension was also assessed among the study population. Though pre-hypertension has not been recognized as a separate category of BP, it has been demonstrated to be an important risk factor for developing hypertension in the future in many studies[10].

Material & Methods

This was a cross-sectional health survey conducted from January 2015 to December 2018 among the tribal population of the Kashmir Valley. Of the 12 districts of Kashmir valley housing tribal population [non-migratory tribes (*Gujjars*) and migratory tribes (*Bakarwals*)], five districts (Anantnag, Pulwama, Ganderbal, Kupwara and Srinagar) were selected randomly. The study was approved by the Institutional Ethics Committee of Sher-I-Kashmir Institute of Medical Sciences (SKIMS), Srinagar. An informed written consent was obtained from all the participants. Individuals aged 20 yr or above residing in the selected study area who gave consent to participate in the study were included.

Study population: After random selection of districts (5/12), one *tehsil* followed by a block and then villages were selected based on multistage cluster sampling with probability proportional to size technique[17]. These villages were exclusively inhabited by tribal population, with a maximum cap of 1000 individuals per village. After liaising with village heads, *panchayat* members, local health authorities and religious leaders, awareness lecture about non-communicable diseases (NCDs) was organized to sensitize the target population. On the following day of the camp, the research staff approached the village residents by house-to-house survey starting randomly from one point. The individuals were handed a subject information sheet with the study protocol (in English or Urdu) that was explained to them by study team members in the presence of local volunteers who would help in interpretation. Those residing in the village for more than one year, aged 20 yr or above and furnished written informed consent were enrolled in the study. Those who refused to participate, was pregnant, could not give complete response due to physical or mental illness and in whom anthropometry or biochemical parameters could not be performed were excluded from the study.

Clinical assessment: Modified WHO-STEPS questionnaire[12] for NCD risk factor surveillance was used to obtain socio-demographic information and to assess the risk factors of hypertension such as smoking (active or passive), indoor pollution, physical activities, housing condition, drinking water and alcoholism. The standardized English language questionnaire was translated to Urdu for easy understanding and validated. To administer the questionnaire, a face-to-face interview was conducted in local

vernacular language by limited number of trained researchers proficient in tribal languages. Revised modified BG Prasad socio-economic classification scale was used to ascertain socio-economic class of the study population[13]. Education was categorized as high (secondary or high school, college or university) and low (primary education or no education)[14].

The anthropometric measurements included measurement of weight, height and calculation of BMI as per the WHO guidelines[15] and were classified as per the consensus Statement of the Association of Physicians of India[16]. The height in centimetre and weight in kilogram were taken as average of three readings using standard scales (SECA 213, Hamburg Germany). BP was measured on the left arm of each individual after being seated for five minutes without prior consumption of coffee or smoke using digital sphygmomanometer (OMRON Model HEM-7203). Three readings were taken 3–5 min apart, and the average of the readings was calculated and taken as the final BP measurement. A brief general physical examination was done to note any relevant findings.

Laboratory assessment: A fasting or random venous blood sample was obtained by trained phlebotomists for haemogram, liver and kidney function tests. Haemogram was measured using automated counter Swelab Alfa Autosampler (Boule Diagnostics, Sweden), while biochemical parameters were measured using fully automated biochemistry analyzer (DiaSys Respons® 910, Germany).

Definition and categorization of hypertension: Joint National Committee on Prevention, Detection, Evaluation and Treatment of high BP (JNC 8)[17] classification was used for diagnosing hypertension. All the participants with a systolic BP (SBP) ≥140 mmHg and/or diastolic BP (DBP) ≥90 mmHg or who reported currently taking medication for the treatment of high BP were classified as having hypertension. Treatment of hypertension was defined as self-reported use of anti-hypertensive medication in the last two weeks. Control of hypertension was defined as pharmacological treatment of hypertension associated with SBP <140 mmHg and DBP <90 mmHg as per the definition issued by the World Hypertension League Expert Committee in 2014[18]. As per JNC8, (*i*) stage 1 hypertension was defined as SBP 140-159 mmHg and/or DBP 90-99 mmHg; (*ii*) stage 2 hypertension was defined as SBP ≥160 mmHg and/or DBP ≥100 mmHg; (*iii*) isolated systolic hypertension was defined as SBP above the cut-off designed for hypertension with normal DBP, while isolated diastolic hypertension was defined as normal SBP with DBP above the cut-off defined for hypertension; and (*iv*) pre-hypertension was defined as SBP above 120 mmHg but less than the cut-off for hypertension and/or DBP between 80 and 89 mmHg in the absence of a diagnosis of hypertension or treatment with medication for high BP.

Categorization of haemogram: Haematological parameters were grouped as follows: total leucocyte count as 10^9/l–<4.0 (low), 4-11 (normal) and >11 (high); haemoglobin (Hb as g/dl)–<11 (low or anaemia), 11-14.99 (normal) and ≥15 (high); haematocrit (HCT as %)–<35 (low), 35-45 (normal) and>45 (high); red blood cell (RBC) count (10^{12}/l)–<4 (low), 4-5.5 (normal) and >5.5 (high), platelet count (PLT as 10^9/l)–<150 (low) and 150-400 (normal) (reference range as per our laboratory).

Sample size was calculated using the prevalence of hypertension reported from Central Kashmir from a previous study[8], which was 34.12 per cent. An absolute precision of two per cent was used to calculate sample size. Although 6808 individuals agreed to participate in the study and were enrolled, only 4038 with complete data were included for final analysis.

Statistical analysis: The data were entered in Microsoft excel and analysed using IBM-SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). Chi-square's test of significance was performed to find out significance of the study results. Frequencies and percentages were calculated to summarize qualitative data. Logistic regression was applied to identify the correlates for hypertension. The odds ratio (OR) was reported with 95 per cent CI.

Results

Socio-demographic characteristics: Of a total of 6808individuals interviewed, 4038 had complete information for final analysis. The mean age of the participants was 43.12 ± 15.69 yr (ranging from 20 to 109 yr). The females were considerably younger than males (40.56±14.41 vs. 46.97±16.73 yr). The mean BMI was 21.9 ± 4.75 kg/m^2 with female participants having a slightly higher BMI (22.26±5.08) than their male counterparts (21.34±4.15). Table I shows the socio-demographic, behavioural and clinical characteristics of the study participants. Odds of having hypertension were higher with increasing age, male sex, smoking and obesity.

Table I. Relation of hypertension with various socio-demographic, behavioural and anthropometric risk factors with unadjusted odds ratio and adjusted prevalence odds ratio

Variables	Total (n)	HTN, n (%)	*P*	Unadjusted OR (95% CI)	Adjusted prevalence OR (95% CI)
Age group (yr)					
20-29	869	165 (19)	<0.001	1.0	1.0
30-39	920	283 (30.8)		1.9 (1.5-2.4)*	1.3 (1.1-1.5)*
40-49	876	371 (42.4)		3.1 (2.5-3.9)*	1.7 (1.5-1.9)*
50-59	548	306 (55.8)		5.4 (4.2-6.9)*	1.9 (1.7-2.1)*
60-69	488	315 (64.5)		7.8 (6.0-10.0)*	2.1 (1.9-2.4)*
≥70	337	232 (68.8)		9.4 (7.1-12.6)*	2.2 (1.9-2.4)*
Gender					
Male	1612	753 (46.7)	<0.001	1.4 (1.3-1.6)*	1.0 (0.9-1.2)
Female	2426	919 (37.9)		1.0	1.0
Socio-economic class					
Lower	3040	1295 (42.6)	0.007	1.3 (0.9-1.8)	1.2 (0.9-1.6)
Others	998	377 (37.8)		1.0	1.0
Education status					
Low	3800	1611 (43.4)	<0.001	2.1 (1.6-2.9)*	0.9 (0.7-1.1)
High	238	61 (25.6)		1.0	1.0
Occupation					
Employed	3436	1372 (39.9)	<0.001	1.0	1.0
Unemployed	602	300 (49.8)		1.5 (1.3-1.8)*	1.0 (0.9-1.2)
Active smoking					
Yes	969	448 (46.2)	<0.001	1.3 (1.1-1.5)*	0.9 (0.7-1.0)
No	3069	1224 (39.9)		1.0	1.0
Passive smoking					
Yes	872	399 (45.8)	0.003	1.3 (1.1-1.5)*	1.3 (1.1-1.5)*
No	3166	1273 (40.2)		1.0	1.0
Family history of HTN					
Yes	431	263 (61.0)	<0.001	2.5 (2.0-3.0)*	1.6 (1.4-1.7)*
No	2369	919 (38.8)		1.0	1.0
BMI					
Underweight	711	259 (36.4)	<0.001	1.0	1.0
Normal	1964	757 (38.5)		1.1 (0.1-1.3)	1.1 (0.9-1.2)
Overweight	531	231 (43.5)		1.3 (1.1-1.7)*	1.1 (0.9-1.3)
Obese	832	425 (51.1)		1.8 (1.5-2.2)*	1.3 (1.1-1.6)*
WC-high risk					
Yes	1755	759 (43.2)	<0.001	1.1 (1.0-1.3)	1.0 (0.9-1.2)
No	2282	913 (37.9)		1.0	1.0
Dyslipidaemia					
Yes	1423	627 (44.1)	<0.001	1.4 (1.1-1.6)*	1.1 (0.9-1.2)
No	972	358 (36.8)		1.0	1.0

*P<0.05. HTN, hypertension; BMI, body mass index; WC, waist circumference; OR, odd's ratio; CI, confidence interval

Burden of hypertension: Overall prevalence of hypertension was 41.4 per cent [95% confidence interval (CI): 39.9-42.9%] with sex-specific prevalence as 46.7 per cent (95% CI: 44.1-49.1%) in men and 37.9 per cent (95% CI: 35.9-39.9%) in women. A total of 951 (23.6%) individuals had normal BP, whereas 1415 (35%) had pre-hypertension. Among the hypertensive individuals, 318 (19%) had isolated systolic hypertension, 415 (24.8%) had isolated diastolic hypertension, whereas 556 (33.25%) had combined hypertension. The mean SBP was 125.40±18.75 mmHg (ranging from a minimum of 86 to a maximum of 180 mmHg) and mean DBP was 81±11.97 mmHg (ranging from a minimum of 50 to a maximum of 126 mmHg). Table II shows age- and sex-wise distribution of categories of hypertension. Of the 1672 hypertensives in our study, 784 were aware of having hypertension, 577 were receiving treatment for hypertension at least for two weeks at the time of participation in the study and 255 participants had their BP controlled as per study definition with anti-hypertensive regimen. The prevalence of awareness, treatment and controlled BP in the study was 46.9, 34.5 and 15.3 per cent, respectively.

Higher age, male gender, lower socio-economic class, lower level of education and unemployment were the socio-demographic factors associated with hypertension. Active/passive smoking was the only behavioural risk factor associated with hypertension in our study apart from family history of hypertension. Among the clinical parameters, increased BMI (overweight or obese) and dyslipidaemia were associated with hypertension (Table I). Univariate analysis using binomial logistic regression method was performed to calculate unadjusted OR of risk factors of hypertension identified by Chi-square test. Multivariate analysis was performed to calculate adjusted OR with 95 per cent confidence interval (Table I). Increasing age [highest adjusted OR for >70 yr - 2.2 (1.9-2.4)], passive smoking [OR-1.3 (1.1-1.5)], family history of hypertension [OR-1.6 (1.4-1.7)] and obesity [OR-1.3 (1.1-1.6)] showed significant adjusted OR for developing hypertension. Adjusted prevalence ratio was also calculated for each risk factors using logistic model with random effects and conditional method of standardization[19] (Table I).

Hb, RBC count and HCT showed significant association with BP. There was weak positive correlation between SBP with Hb (r=0.07, P=0.03), RBC count (r=0.084, P=0.01) and HCT (r=0.08, P=0.02). Similarly, there was a weak positive correlation between DBP with Hb (r=0.09, P=0.004), RBC count (r=0.102, P=0.003) and HCT (r=0.12, P=0.001).There was significant difference between the means of normotensives compared to hypertensives with regard to RBC count, red cell distribution width (RDW) and PLT (Table III).

Discussion

The prevalence of hypertension in our study was 41.4 per cent which was higher than reports from various tribal populations from other parts of India (16-26%)[7,20]. This was also higher than the national figures quoted by the WHO in 2015 (23.5%)[21]. The results of survey conducted by The National Nutrition Monitoring Bureau (NNMB) in 2009 revealed that among the adult tribal population of India, the prevalence of hypertension was 25 per cent among men and 23 per cent among women, which was comparable to that reported for rural adults[22]. The altitude of villages included in our study ranged from 1585-2406 m above sea level. Although residence at higher altitude has been earlier attributed to account for lesser prevalence of hypertension[7], a systematic review showed that higher altitude was associated with increased prevalence of hypertension[23]. In this study, the authors noted two per cent increase in prevalence of hypertension with every 100 m increase in altitude above sea level[23]. However, we found no correlation between altitudes of villages studied with the prevalence of hypertension from respective villages (data not shown).

Even though our study was conducted in tribal areas, the prevalence of hypertension reported was similar to the prevalence reported from urban areas in different parts of India and significantly higher than the prevalence reported from rural areas[4,5,24-26]. This could be due to rapid urbanization as well as the changing lifestyle of tribes. While smaller epidemiological studies of hypertension among general population from various regions of Jammu and Kashmir reported prevalence of hypertension to be around 34-57 per cent[8,27,28], no study to assess the prevalence among tribals of Kashmir has been conducted before. The prevalence of prehypertension in our study was 35 per cent (male – 33.3%, female – 36.2%) which was in accordance with the prevalence of prehypertension noted in most of the studies from other parts of India[3,20,25].

Men exhibited higher prevalence of hypertension than women in our study which was

Table II. Mean systolic and diastolic blood pressure (mmHg) by age, gender and blood pressure categories

Age group (yr)	n	BP categories	n (%)	Mean±SD		Under treatment, n (%)
				Systolic BP	Diastolic BP	
Male						
20-29	275	Normal	94 (34.2)	108.5±6.7	69.4±6.5	-
		Pre-HTN	132 (48)	122.1±7.4	77.9±6.1	-
		HTN	49 (17.8)	131.9±17.4	86.7±11.3	10 (20.4)
30-39	300	Normal	79 (26.3)	107.1±7.0	68.3±6.2	-
		Pre-HTN	123 (41)	121±9.9	79.6±5.7	-
		HTN	98 (32.7)	138.2±18.9	88.6±10.5	23 (23.5)
40-49	320	Normal	71 (22.2)	106.5±7.1	70.3±5.2	-
		Pre-HTN	115 (35.9)	123.5±8.6	79.2±5.3	-
		HTN	134 (41.9)	139.1±18.6	89.4±12	43 (32.1)
50-59	251	Normal	35 (13.9)	105.8±7.8	70.2±4.7	-
		Pre-HTN	75 (29.9)	122.7±7.7	80.1±5.4	-
		HTN	141 (56.2)	142.9±16.6	90.1±12.2	37 (26.2)
60-69	253	Normal	22 (8.7)	108.2±8.0	70.5±6.3	-
		Pre-HTN	55 (21.7)	124.4±8.3	80.6±5.1	-
		HTN	176 (69.7)	145±18.5	91.2±12.1	70 (39.8)
≥70	213	Normal	22 (10.3)	110.4±7.9	69.8±6.1	-
		Pre-HTN	36 (16.9)	122.2±9.5	78.2±6.1	-
		HTN	155 (72.8)	146.3±18.4	90.9±12.6	71 (45.8)
Overall	1612			128.6±19.5	82.3±12.2	254 (33.7)
Female						
20-29	594	Normal	222 (37.4)	106.1±7.1	68.6±6.3	-
		Pre-HTN	256 (43.1)	119.1±7.7	79.1±5.7	-
		HTN	116 (19.5)	129.7±21.2	83.8±13.1	28 (24.1)
30-39	620	Normal	192 (31)	107.2±7.3	69.9±6.4	-
		Pre-HTN	243 (39.2)	122.6±7.6	79.7±6.0	-
		HTN	185 (29.8)	133.8±18.8	88.0±12.4	49 (26.5)
40-49	556	Normal	`123 (22.1)	106.6±7.0	70.2±5.6	-
		Pre-HTN	196 (35.3)	121.2±8.6	80.0±5.5	-
		HTN	237 (42.6)	136.3±18.1	88±12.4	90 (38)
50-59	297	Normal	46 (15.5)	106.5±5.9	69.4±5.8	-
		Pre-HTN	86 (29)	121.3±8.7	79.9±6.2	-
		HTN	165 (55.5)	138.1±19.8	89.1±12.3	58 (35.2)
60-69	235	Normal	33 (14)	108.2±7.0	69.4±6.8	-
		Pre-HTN	63 (26.8)	123.5±8.4	78.5±6.6	-
		HTN	139 (59.2)	141.4±19.7	90.1±13.2	63 (45.3)
≥70	124	Normal	12 (9.7)	107.6±8.9	68.8±5.5	-
		Pre-HTN	35 (28.2)	125.5±7.6	79.7±5.5	-
		HTN	77 (62.1)	141.0±19.1	89.5±13.3	35 (45.5)
Overall	2426			123.3±17.9	80.2±11.7	323 (35.1)

SD, standard deviation; BP, blood pressure; HTN, hypertension

Table III. Comparison of haemogram parameters between hypertensive and normotensive subgroups

Parameter	Normotensive group, n=951	Hypertensive group, n=1672
TLC (10^9/l)	7.13±1.94	7.09±2.14
Haemoglobin (g/dl)	12.76±2.25	12.93.1±2.35
MCH (pg)	26.34±3.5	26.4±3.15
MCHC (g/dl)	30.65±1.82	30.51±1.76
RBC (10^{12}/l)	4.86±0.64	4.92±0.76*
MCV (fl)	85.93±10.64	86.64±10.52
HCT (%)	41.66±6.78	42.50±7.47
RDW (%)	28.13±25.39	29.89±27.75*
PLT (10^9/l)	155.9±72.92	147.43±63.03*
MPV (fl)	12.12±1.59	11.87±1.53

*$P<0.05$ compared to normotensive group. TLC, total leucocyte count; MCV, mean corpuscular volume; RBC, red blood cell; MCH, mean corpuscular haemoglobin; PLT, platelet count; RDW, red cell distribution width; HCT, haematocrit; MCHC, mean corpuscular haemoglobin concentration; MPV, mean platelet volume

in accordance with most epidemiological studies of hypertension[3,5,7,10,14,20,24,25,28]. Age was found to be the most important risk factor for hypertension with the mean systolic and diastolic BPs showing linear increase with advancing age in both sexes. Prehypertension showed reverse trend with highest prevalence noted in youngest age group, *i.e.* 20-29 yr. Prehypertension is one of the established risk factors for developing hypertension[10]; young adults in our study may be at increased risk for developing hypertension in the near future. Similar results were noted in a few other studies[20,29] indicating that lifestyle diseases such as hypertension are no longer limited to elderly population.

Higher socio-economic status and higher level of education were associated with lesser prevalence of hypertension which was in accordance with results of previous studies[30]. Active and passive smoking were also found to be significantly associated with hypertension in our study. There was no association noted between alcoholism and hypertension which might be accounted by low prevalence of alcoholism among our study participants (1.7%).

Obese individuals and those with increased WHR had increased prevalence of hypertension. There was also progressive increase in the prevalence of hypertension with increasing class of BMI and dyslipidaemia. Similar findings were seen in most of the epidemiological studies of hypertension[3-5,8,14,25,31,32]. There was a significant positive correlation between SBP/DBP with HCT, Hb and RBC count. Hypertensive individuals had a greater mean RBC count and RDW but lesser mean platelet count than normotensives. These findings were in accordance a previous study, but our study was not designed to assess the potential pathogenic or causal association between these haematological parameters and prevalence of hypertension.

The prevalence of awareness, treatment and controlled BP in our study was 46.9, 34.5 and 15.3 per cent, respectively. This was higher than the prevalence rate reported from rural India and comparable to the figures of urban dwellers in a meta-analysis which revealed the prevalence of awareness, treatment and control of BP as 25.3, 25.1 and 10.7 per cent, respectively, for rural Indians and 42.0, 37.6 and 20.2 per cent, respectively, for urban Indians[4]. Tribal population of Kashmir appeared to be doing well in this regard compared to the tribal population from rest of the country where awareness rate was as low as 8.4 per cent[34].

The present study had some limitations. Majority of the study participants were illiterate which renders their response to the study questionnaire less reliable. No data were collected regarding the stress levels of participants, daily salt intake and urinary sodium excretion, all of which are important risk factors of hypertension. We also did not collect information regarding nature of treatment received by the participants who were being treated for hypertension in our study.

In conclusion, hypertension was found to be prevalent among Kashmiri tribals with high prevalence of prehypertension among the younger participants, placing them at higher risk for developing hypertension in future. Thus, urgent policies need to be devised to prevent emergence of risk factors among the tribal community of Kashmir valley, especially among the youth.

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