

# Undiagnosed elevated blood pressure and its life style related risk factors among adults: Cross sectional survey

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## ABSTRACT

**Background:** Globally, high blood pressure (BP) is a main health problem among adult population. High BP is considered as a major risk factor which may lead to many cardiovascular diseases. Globally, it is also the leading cause of death. According to the American Heart Association, a BP of 120/80 mm of Hg is a normal range but when the systolic blood pressure  $\geq 130$  and diastolic blood pressure  $\geq 80$ , it is always labeled as hypertension. **Objectives:** In the present study, the researchers wanted to identify the prevalence of undiagnosed elevated blood pressure in the adult population of Uttarakhand, India and also try to explore its lifestyle-related risk factors. **Methods:** This study was an exploratory survey with a cross-sectional design. Data were collected from 440 participants by using the cluster sampling technique. **Results:** The male:female ratio among participants was 1:4 and most of the participants were aged 25-30 years. The study found that the prevalence of high blood pressure was 26%, in which marginal elevated BP prevalence was 16%, hypertension stage I was 7%, and hypertension Stage II was 3% which is significantly higher in number at a young age. Lifestyle-related risk factors showed a significant association of hypertensive status with gender, consumption of balanced diet, and personal habits. This increases the chances of elevated blood pressure in young adults. **Conclusion:** All health professionals must be sensitized for elevated blood pressure problems among the young adult populations. Elevated blood pressure should be considered as a warning alarm at an early age when prescribing any medication and during any invasive procedure. Awareness should be created among public regarding elevated blood pressure issues at a younger age and motivate people to adopt a healthy and stress-free lifestyle.

**Keywords:** Cholesterol, elevated blood pressure among young adults, high density lipoprotein, lifestyle related risk factors for elevated blood pressure, prevalence of elevated blood pressure, undiagnosed elevated blood pressure

## Introduction

High blood pressure is a major non-communicable disease which is equally affecting the rural and urban populations.<sup>[1]</sup> Under extreme conditions, when it is not managed, it may lead to further deterioration of the health condition of a person such as chronic illness, myocardial infarction, stroke, and renal

failure. An estimated 1 to 13 billion people around the world have hypertension, while 2/3 of them belong to low-middle-income countries. It is a problem which is reducing the growth and productivity of these countries.<sup>[2]</sup> A heart study report stated that out of 100, 90 persons will develop high BP problem around the age of 55 years, which is really a significant number.<sup>[3]</sup> Nowadays, high BP diagnosis cases in younger people are increasing day by day, which could be a serious issue in the future.<sup>[4]</sup> This should be addressed in an earlier phase.<sup>[5]</sup> The global obesity epidemic is a leading risk factor for high BP of a shift in high blood pressure distribution among young adults.<sup>[6]</sup> In India, a systematic review

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revealed that around 33% of the urban population and 25% of the rural population are hypertensive.<sup>[7]</sup> About 1 out of 10 rural and 1 out of 5 urban areas are hypertensive. Only 25% rural and 42% urban Indians have information regarding their diagnosis. Among them, 100% of the rural population and 90% of the urban population were receiving treatment.<sup>[8]</sup>

Studies have reported that raised blood pressure problems are more common in children and adolescents nowadays due to obesity. When these people reach a young adult age group, they are also at great risk for hypertension in their future life.<sup>[9]</sup> The majority of people are only diagnosed with hypertension when it requires treatment, but not before that/incidental, i.e., screening for any medical/surgical management.<sup>[10]</sup> According to the American Heart Association (AHA), the criteria for elevated-blood pressure are systolic blood pressure 120–129 mm Hg and diastolic blood pressure less than 80 mm Hg. In hypertension stage I, the systolic blood pressure is 130–139 mm Hg and diastolic blood pressure is 80–89 mm Hg and in hypertension stage II, systolic blood pressure is more than 140 mm Hg and diastolic blood pressure is more than 90 mm Hg. In the prehypertension stage, a person is asymptomatic, and hence is may not be considered as a disease but could be a warning sign to alert us. Elevated blood pressure, which most of the time is unnoticed, could be a silent killer. It pressure rarely exhibits any signs or symptoms. Many young adults go unnoticed for this problem and get noticed only in the later stages of life only when they suffer from hypertension.<sup>[6]</sup>

A study conducted in West Bengal showed that the prevalence of prehypertension and hypertension was 31.9% and 24.1%, respectively.<sup>[9]</sup> Another cross-sectional study conducted in Punjab done on 5127 participants showed that the prevalence of hypertension and prehypertension was 40.1% and 40.8%, respectively. Of the 40.1%, only 30.1% were known cases of hypertension and who were on treatment also. The study concluded that the prevalence of undiagnosed hypertension was very high which is still undiagnosed and has a health problem.<sup>[11]</sup> Early identification of elevated blood pressure and its risk factors is always an essential pre-requisite. This paper will help us to identify the prevalence of hypertension in Rishikesh and emphasize screening as per the NPCDCS programme and identify the cases in the primary health-care level itself to prevent from further morbidities in future. So the main aim of this study was to identify the prevalence of undiagnosed raised blood pressure and its lifestyle-related risk factors among young adults in Rishikesh town, Uttarakhand.

## Material and Methods

A community based cross-sectional study was conducted in 2019 for a duration of one year among people aged 18 years and above residing in various areas of Rishikesh. Assuming a prevalence of 32.5%, the sample size was calculated to be 260 by keeping a relative precision of 18%. Applying a design effect of 1.5, the sample size was calculated to be 410. Considering a

drop-out rate of 5%, the final sample size was calculated to be 410 and we have taken 440 subjects. Sample size was calculated using the formula  $n = 4(pq/L^2)$ , where  $P$  = assumed prevalence of HTN,  $q = 1 - p$ , and  $L$  = absolute precision.

Sampling was done using the cluster sampling technique. Rishikesh city has a total of 20 wards. Of the 20 wards, 10 clusters were selected. By using the random sampling method, a total of 44 samples from each cluster were taken. Data were collected by house visit. Institute Ethical Committee (IM/RC69/2015/07) on dated 27.8.2016 and written informed consent was obtained from each participant before being included in the study. The inclusion criteria for this study were age 18-45 years, willingness to participate in study and no mental and congenital deformities. Data collection tools used include sociodemographic datasheet, clinical profile, modified WHO-Steps approach questionnaire, blood pressure assessments, and blood sample for analysis of lipid profile including cholesterol, triglyceride, and high-density lipoprotein.

### Step I

The sociodemographic datasheet data and modified WHO-steps questionnaire were used to collect data by using the interview method. **Step II:** Blood pressure was measured by a trained personnel. The interrater reliability, i.e., Cohen's kappa was calculated ( $\alpha = 0.90$ ) which showed excellent agreement for blood pressure measurement. **Step III:** Protocol for blood pressure measurement: The person was allowed to sit comfortably and relax for 5 minutes and the the digital sphygmomanometer was set at the heart level. The size of the cuff can be adult size except for the obese person [(mid-arm circumferences more than 33 cm) 9.5–12 inches (Regular adult cuff); 13–16.5 inches (Large adult cuff)]; the cuff was secured by tucking the end of fixing with the Velcro fastener. The arm was kept well-rested and supported. The radial pulse was palpated and the cuff was inflated until the pulse was obliterated. Palpate the brachial artery and place the diaphragm of the stethoscope lightly over the brachial artery. When the first sound is heard, the mercury level is noted. This indicates the systolic blood pressure and continue to deflate the cuff and when the sound disappears, denote the diastolic blood pressure.<sup>[12]</sup> Repeat the procedure after 10 minutes and three consecutive readings were taken in an interval of 10 minutes each. The mean of these three readings was calculated, and the systolic and diastolic blood pressure were calculated and recorded as the final reading. The tools used for blood pressure measurements were validated and calibrated. **Step IV:** Blood sample for checking lipid profile. All serum samples were collected after 10–12 hrs. Fasting condition was analysed for lipid profile parameters serum triacylglycerol, total cholesterol, LDL, and HDL on the same day of collection at the Clinical Biochemistry laboratory, AIIMS, Rishikesh with the use of a Beckmann Coulter 680 fully automated chemistry analyser after standardization with controls and calibrators. The results were reported as mg/dl for each analysis.

Descriptive statistics, i.e., frequency and percentage values explain the sociodemographic data, lifestyle-related risk factors, and lipid profile. Chi-square values and odds ratio were calculated to identify the association of causes and effects of the relationship for lifestyle-related risk factors and elevated blood pressure.

Categories I, II, III, and IV were used for consumption of balanced diet in which category I means milk, curd, tea, and coffee were consumed. Category II means milk, curd, tea, coffee, cereals, paneer and legumes/pulses-soya were used in diet. Category III means milk, curd, tea, coffee, cereals, legumes/pulses-soya, paneer, tomato, guava, and green vegetables were used in diet. Category IV means milk, curd, tea, coffee, cereals, legumes/pulses-soya, paneer, eggs, dry fruits, meat, fish, lemon, amla, tomato, guava, and green vegetables were regularly used in diet.

Acute disease included in this study were asthma, urinary tract infection, pain, and migraine. Chronic disease included diabetes mellitus, heart disease, rheumatoid arthritis and thyroid disease. The World Health Organization (WHO) criteria for body mass index (BMI) were used in the study. A BMI of less than 18.5 kg/m<sup>2</sup> was considered underweight and a BMI of 18.5–24.9 kg/m<sup>2</sup> was considered normal weight, a BMI of 25–29.9 kg/m<sup>2</sup> was considered pre-obesity and a BMI of 30–39.9 kg/m<sup>2</sup> was considered as obesity class I.

## Results

80% (352) of the study participants were female. The male to female ratio of the study population was 1:4. Most of the samples (32%) belong to young participants of age 25–30 years and about 32% were graduate. For about 62%, the monthly income is 0–10,000 which indicated that majority of the participants belong to low socioeconomic status. The majority of the population (77%) were either housewives or shop owners [Table 1].

The lifestyle data depicted that the majority (62%) of the participants used to work for 2–4 hours a day only and a majority (87%) were not doing any exercise which indicates they used to have a sedentary lifestyle. About 54% were have mixed diet pattern which includes meat, fish, and egg/week in their diet. Only 39% were consuming a balanced diet pattern of category IV which includes milk, curd, tea, coffee, cereals, legumes/pulses-soya, paneer, eggs, dry fruits, meat, fish, lemon, amla, tomato, guava, green vegetables etc.

A majority of the participants were not subjected to bad habits and a majority of them had no diseases (89%). Only 11% were diagnosed with diseases and are under treatment. So, a majority of the patients were fit and do not have any disease and were not using any medication. A total of 80.5% participants have an underweight (9.5%) BMI or healthy (71%) BMI. Only 19.5% participants were having higher BMI which could be a risk factor for elevated blood pressure [Table 2].

**Table 1: Sociodemographic Data sheet n=440**

Sr. No.	Variables	Subgroups	Frequency	Percentage %
1.	Age	< 20 years	9	02
		20-25 years	68	16
		25-30 years	144	32
		30-35 years	96	22
		35-40 years	110	25
		>40 years	13	03
2.	Gender	Male	88	20
		Female	352	80
3.	Qualification	Illiterate	35	08
		8 <sup>th</sup> class	110	25
		10 <sup>th</sup> class	67	16
		12 <sup>th</sup> class	84	19
		Graduate and more	144	32
4.	Economic Status	Not adequate	79	18
		0-5000 Rs per month	143	32
		5000-10000 Rs per month	135	30
		10000-15000 Rs per month	37	9
		>15000 Rs per month	46	11
5.	Occupation	No work	18	4
		Shop owner/Housewife	340	77
		Agriculture	39	8
		Others	37	8
		Laborer	3	1
		Govt. Job	13	2

The lipid profile data depicted that a majority (84%) of participants have a cholesterol level in the desirable level (< 200 mg/dl). For 95% of participants, the cholesterol values lie between 157.66–175.80, which is in a desirable level. About 87% participants were having triglyceride levels in the desirable level (<200 mg/dl) and 95% have triglyceride levels of 121.35–137.51 which is also a desirable level. Only 10% participants were having HDL levels in the desirable level (>50 mg/dl), which is a very low number. About 95% have their high density lipoprotein levels between 39.10–40.93, which is in the borderline low range [Table 3].

A majority (74%) of the participants were having normal blood pressure. The prevalence of elevated blood pressure was about 26%; elevated blood pressure (16%), hypertension stage I (7%) and hypertension stage II (3%) which is again a significant high number indicating more undiagnosed cases. A 95% confidence interval for systolic BP [120.47–122.24] is the normal range of systolic BP and 80.76–82.28 is the normal for diastolic BP [Table 4].

The Chi square test showed a significant association of hypertensive status with gender, consumption of balanced diet, and personal habits. The consumption of a balanced diet showed significant association with those who are consuming category IV food being at a risk for hypertension. Personal habits showing

**Table 2: Frequency and percentage of factors related to life style of adults n=440**

Sr. No.	Variables	Subgroups	Frequency	Percentage %
1.	Exercise	0 hours per day	382	87
		<30 minutes per day	40	9
		1 hour per day	2	0
		>1 hour per day	16	4
2.	Diet pattern	Pure vegetarian	198	46
		Mixed diet (Meat, fish, egg-every week)	242	54
3.	Consumption of balance diet	Category I	32	7
		Category II	108	25
		Category III	126	29
		Category IV	174	39
4.	Personal habits	No addiction	410	93
		Smokeless form of tobacco addiction	8	2
		Smokeless form of tobacco addiction	3	1
		Alcohol addiction	19	4
5.	Suffering of any disease	No disease	387	89
		Acute disease	29	5.5
		Chronic disease	24	5.5
6.	Body Mass Index (BMI)	< 18.5 kg/m <sup>2</sup> (Underweight)	42	9.5
		18.5-24.9 kg/m <sup>2</sup> (Normal weight)	306	71
		25-29.9 kg/m <sup>2</sup> (Pre-obesity)	81	17
		30-39.9 kg/m <sup>2</sup> (Obesity Class I)	11	2.5

**Table 3: Distribution of study participants according to their lipid profile**

Sr. No.	Variables	Subgroups	Number n=440	Percentage %
1.	Total cholesterol (TC)	< 200 mg/dl (desirable level)	358	84
		200-239 mg/dl (borderline high level)	68	14
		240 mg/dl (high level)	7	2
2.	Triglyceride (TG)	<200 mg/dl (desirable level)	373	87
		200-399 mg/dl (borderline high level)	53	11
		>400 mg/dl (high level)	7	2
3.	High-density lipoprotein (HDL) level	>50 mg/dl (desirable level)	46	10
		40-49 mg/dl (borderline low level)	154	36
		<40 mg/dl (lower level)	240	54

**Table 4: Distribution of study participants' blood pressure according to the American Heart Association classification n=440**

Sr. No.	Variables	Sub groups	Number	Percentage %
1.	Blood Pressure	Normal BP	320	74
		Elevated BP	76	16
		Hypertension Stage I	30	7
		Hypertension Stage II	14	3

a significant association means that nonaddicted personnel also have chances for hypertension.

Participants of age 40–45 years had 1.45 times higher chances of having hypertension. Females had 2.38 times more chances for hypertension than males. Participants who did not exercise have 1.16 times higher chance of hypertension than those exercising for more than 30 minutes. People who were not suffering from medical diagnostic diseases were 1.03 times more at risk than

those diagnosed with acute or chronic diseases. A person with a BMI higher than or equal to 25–29.9 kg/m<sup>2</sup> were 1.1 times more chances for having hypertension rather than a normal BMI. A person whose triglyceride levels were in high level range had a 1.47 times higher chance for having hypertension rather than normal triglyceride. People with high-density lipoprotein levels in the lower range had a 1.27 times higher chance of having hypertension than the desirable range [Table 5].

Correlation coefficient values showed a weak positive correlation of total cholesterol and triglyceride with hypertensive status meaning that cholesterol levels of more than 200 mg/dl will lead to increased blood pressure. A triglyceride level of more than 200 mg/dl also leads to increased blood pressure. The high-density lipoprotein level showed a negative correlation with hypertensive status which means a decrease in the high-density lipoprotein level again leads to increased blood pressure. So there are increasing chances of having hypertension [Table 6].

**Table 5: Association of risk factors with hypertensive/nonhypertensive n=440**

Sr. No.	Variables	Subgroups	HTN PRESENT (n=117)	HTN ABSENT (n=323)	Odd's Ratio	$\chi^2$	P
1.	Age	< 20 years	1	8	1	3.418	0.636
		20-25 years	16	54	2.37 [0.28,20.4]		
		25-30 years	39	100	3.12 [0.38,25.77]		
		30-35 years	30	68	3.53 [0.42,29.49]		
		35-40 years	29	82	2.83 [0.34,23.61]		
		40-45 years	2	11	1.45 [0.11,18.96]		
2.	Gender	Male	39	56	1	12.981	<b>0.000*</b>
		Female	78	267	2.38 [1.47-3.85]		
3.	Qualification	Illiterate	8	27	1	2.606	0.626
		8 <sup>th</sup> class	30	84	1.21 [0.49-2.94]		
		10 <sup>th</sup> class	23	44	1.76 [0.69,4.5]		
		12 <sup>th</sup> class	22	65	1.44 [0.45,2.88]		
		Graduate and more	34	103	1.11 [0.46,2.68]		
4.	Economic Status	Not adequate	18	61	1	2.850	0.583
		0-5000 rs per month	42	96	1.48 [0.78-2.81]		
		5000-10000rs per month	32	106	1.02 [0.53-1.98]		
		10000-15000 rs per month	11	28	1.33 [0.56-3.19]		
		>15000 rs per month	14	32	1.48 [0.65-3.36]		
5.	Occupation	No work	3	15	1	1.771	0.880
		Shop owner/Housewife	91	236	1.93 [0.55-6.82]		
		Agriculture	9	32	1.41 [0.33-5.96]		
		Others	10	28	1.79 [0.43-7.5]		
		Laborer	1	2	2.5 [0.17-37.26]		
		Govt. Job	3	10	1.5 [0.25-8.98]		
6.	Exercise	0 hours per day	103	279	1	0.206	0.650
		<30 minutes per day	14	44	1.16 [0.61-2.21]		
7.	Diet pattern	Pure vegetarian	46	153	1	2.328	0.127
		Mixed diet (Meat, fish, egg-every week)	72	169	0.71 [0.46-1.08]		
8.	Consumption of balance diet	Category I	5	27	1	8.291	<b>0.040*</b>
		Category II	28	85	1.78 [0.63-5.06]		
		Category III	27	99	1.47 [0.52-4.19]		
		Category IV	57	112	2.75 [1,7.52]		
9.	Personal habits	No addiction	103	303	1	4.016	<b>0.045*</b>
		Alcohol, smokeless, and smoke addiction	14	20	0.49 [0.24-1]		
10.	Suffering of any disease	No medical diagnosed disease	105	289	1	0.007	0.935
		Diagnosed with Acute or chronic disease	12	34	1.03 [0.51-2.06]		
11.	Body Mass Index Level	Less than or equal to 18.5- 24.9 kg/m <sup>2</sup>	92	256	1	0.106	0.745
		Higher than or equal to 25- 29.9 kg/m <sup>2</sup>	21	64	1.1 [0.63-1.89]		
12.	Total Cholesterol (TC)	< 200 mg/dl (Desirable level)	38	292	1	1.980	0.922
		200-239 mg/dl (Borderline high level)	5	63	0.61 [0.23-1.61]		
		240 mg/dl (High level)	1	14	0.55 [0.07-4.29]		
13.	Triglyceride (TG)	<200 mg/dl (Desirable level)	38	335	1	7.451	0.281
		200- 399 mg/dl (Borderline high level)	4	49	0.72 [0.25-2.1]		
		>400 mg/dl (High level)	2	12	1.47 [0.32-6.81]		
14.	High density lipoprotein (HDL) Level	>50 mg/dl (Desirable level)	3	44	1	8.417	0.209
		40-49 mg/dl (Borderline low level)	23	131	2.58 [0.74-8.99]		
		<40 mg/dl (Lower level)	19	220	1.27 [0.36-4.47]		

\* Significant at 0.05 level

## Discussion

Hypertension is the third most-common noncommunicable disease globally. At an advanced stage, if not treated, it may lead to premature death. In this modern era, most of the young population are following a sedentary life which is the most common lifestyle-related factor for elevated blood pressure.

The prevalence of a higher BMI of 19.5% could be a lifestyle risk factor for elevated blood pressure. The study found that the prevalence of higher cholesterol and triglyceride was 16% and 13%, respectively. The prevalence of a lower high-density lipoprotein (HDL) level was 90%. The prevalence of elevated blood pressure was also high, i.e., about 26%; of this 26%, 16% have elevated blood pressure, 7% have hypertension stage I,

**Table 6: Pearson's Correlation of hypertension/nonhypertensive with lipid profile n=440**

Variables	Hypertensive/Nonhypertensive level	Strength of Correlation
Total cholesterol	0.088	Weakly positive
Triglyceride level	0.031	Weakly positive
High-density lipoprotein level	-0.002	Weakly negative

and 3% have hypertension stage II which indicates the iceberg phenomena for elevated blood pressure. So more and more screening of health camps should be emphasized to rule out a problem in the early stages. Further studies also showed a similar prevalence of prehypertension and hypertension in the younger population—31.9% and 24.1%, respectively.<sup>[9]</sup> A study conducted in Bangladesh observed that the prevalence of undiagnosed hypertension was 59.9% in the study population during the survey and it was not diagnosed before this study.<sup>[13]</sup> The study from the Nepalese population showed that about 56.9% were undiagnosed.<sup>[14]</sup>

Studies showed that the common risk factors for prehypertension and hypertension were age groups of 40–49 years, female gender, nuclear family, Hindu religious people, class III socioeconomic status, higher BMI, smoking, alcohol, high salt intake, and less physical activity. Significant associations were found with age, type of family, socioeconomic status, BMI, salt intake, alcohol consumption, and smoking ( $P < 0.05$ ).<sup>[9]</sup> In this current study, a significant association of hypertensive status with gender, consumption of balanced diet, and personal habits were found. Being female and consumption of balanced diet showed significant association means those who are consuming category IV diet which included no-vegetarian food were at risk for hypertension. Nonaddictive personnel also had greater chances for being hypertensive than those addicted.

The Odd's ratio also showed that people who were not suffering from any medical diagnosed disease were 1.03 times and a person with a BMI higher than or equal to 25–29.9 kg/m<sup>2</sup> were 1.1 times more at risk for hypertension. A person whose triglyceride levels were in the borderline high level range had a 1.39 times higher chance for having hypertension.

The positive correlation of total cholesterol and triglyceride with hypertensive status indicated that as the cholesterol level increases above 200 mg/dl, then there are more chances of having increased blood pressure. With triglyceride levels increasing by more than 200 mg/dl, then there are chances of increase blood pressure. High-density lipoprotein level showed negative correlation with hypertensive status which means as the high density lipoprotein level decrease below 50 mg/dl, it leads to increased blood pressure and vice versa. So there are increasing chances for having hypertension. The WHO report found that lifestyle-related factors including sedentary lifestyle, incorrect choice of food, lack of physical activity, and persistent

exposure to stress are the most common other factors which mainly predispose the development of hypertension.<sup>[15]</sup>

The results also showed that people with high cholesterol and high triglyceride levels showed a lower high-density lipoprotein values in blood samples, pointing toward warning signs for elevated blood pressure in further life.<sup>[16]</sup> This early recognition of risk factors and early management leads to more emphasis on the prevention of diseases than treating after its progression and prevent further complications also.

## Conclusion

In the young adult's population, females have more chances of elevated blood pressure. So, they should be ruled out for undiagnosed elevated blood pressure. They are unaware of their elevated blood pressure problems at a young age and reach out to health-care facilities only when treatment is the only choice. So, more and more emphasis should be given on prevention and screening. Young adults who are in a productive age group in their lifetime should have a proper screening program at the age of 20 onwards for elevated blood pressure, cholesterol, triglyceride, and HDL level. The screening facilities should be available in all primary health centers, i.e., routine blood pressure readings and routine lipid profile tests so that problems can be identified earlier and health promotion activities can be emphasized. The public should be made aware regarding undiagnosed blood pressure issues and motivated to adopt preventive measures for it.

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## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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