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Ambika Rani Yadav
Department of Family and Community Sciences, Faculty of Sciences, University of Allahabad, Prayagraj 211022, India, ambika.ry5320@gmail.com

Priya Keshari
Department of Family and Community Sciences, Faculty of Sciences, University of Allahabad, Prayagraj 211022, India, priya.bhu2010@gmail.com

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Threat of Hypercholesterolemia in Urban Adults and Its Associates: Evidence from a Community-Based Study

Ambika Rani Yadav, Priya Keshari*

Department of Family and Community Sciences, Faculty of Sciences, University of Allahabad, Prayagraj 211022, India

Abstract

Background: Hypercholesterolemia is an abnormality of lipids. It is a crucial modifiable risk factor for cardiovascular diseases. There is a paucity of community-based studies on hypercholesterolemia in the adult population in India. Given this context, the study aims to assess the prevalence and spectrum of hypercholesterolemia, along with its associated factors, among adult residents of urban areas in Prayagraj district, Uttar Pradesh, India.

Methods: This community-based cross-sectional study was done on 536 urban adult subjects (30 to 59 years) of Prayagraj, India, selected by multistage sampling procedure. The predesigned and pretested interview schedule was used to obtain socio-demographic information about subjects. Nutritional parameters and serum cholesterol were assessed using the standard procedure. Statistical analysis was done using the Statistical Package for Social Sciences. The chi-square test and logistic regression analysis were done for association and inferential purposes, respectively.

Results: The prevalence of Hypercholesterolemia was 24.4%. This was significantly ($p < 0.05$) higher in subjects aged 50-59 years, family size 2-4, and having higher body mass index, waist circumference, and visceral fat%. Age emerged as a significant predictor of hypercholesterolemia.

Conclusions: One out of 4 urban subjects had hypercholesterolemia. This study emphasizes the need for age-specific screening and preventive and promotive services to reduce hypercholesterolemia.

Keywords: adult, cardiovascular system, disease, hypercholesterolemia, urban, visceral

INTRODUCTION

The world is witnessing an increasing burden of non-communicable diseases. Changing social and cultural contexts and individual lifestyles have contributed to the surge of these diseases. Globally, non-communicable diseases in general and cardiovascular diseases (CVDs) in particular are the leading causes of mortality. Higher death rates due to CVDs have been reported among low- and middle-income countries.[1,2] Across the world, India has one of the highest burdens of cardiovascular diseases. Hypercholesterolemia is one of the most potential risk factors for cardiovascular diseases. The abnormal increase in the total cholesterol level enhances the likelihood of dying of a person from heart disease. Hypercholesterolemia is of two types: primary and secondary. Primary hypercholesterolemia is the result of a genetic mutation in the low-density lipoprotein (LDL) receptor gene, accounting for 85% of all familial causes.[2–4] The secondary or acquired form of hypercholesterolemia can be attributed to an excessive intake of dietary cholesterol, smoking, hormonal imbalance, and diabetes mellitus.[1,5]

***Corresponding author:**
Priya Keshari
Department of Family and Community Sciences,
Faculty of Sciences, University of Allahabad, Prayagraj, India
E-mail: priya.bhu2010@gmail.com

Based on the report Global Epidemiology of Dyslipidemia, 1 in 3 adults have a high cholesterol level, which accounts for 56% of ischemic diseases and 18% of stroke cases in both genders worldwide.[2] The American Heart Association (2018) has reported that 11.9% of the adult population (aged ≥20 years) have high levels of total serum cholesterol.[6,7] Recent evidence supports an increasing trend of hypercholesterolemia in low-income and lower-middle-income countries, including India.[5,8] The overall prevalence of high total cholesterol in India varies from 13.8% to 48.2%.[5]

In India, very few studies have been conducted on the epidemiology of cholesterol and other lipid profiles on large samples in the past two decades. Moreover, these studies were conducted among industry workers,[9] migrants,[10] or women.[11] Multisite Indian Council of Medical Research Integrated Disease Surveillance Project[12] and India Heart Watch[13] studies have also reported the prevalence of hypercholesterolemia. However, the primary focus of these studies was non-communicable diseases; none of these studies have provided exclusive reports on hypercholesterolemia and its associated factors. As per the literature search, no study has been conducted in an urban setting in eastern Uttar Pradesh, India. A study conducted in the rural setting of this region reported 7 out of 20 subjects having elevated blood triglycerides.[14]

Despite the guidelines provided by the National Cholesterol Education Program (NCEP) for the early detection, evaluation, and treatment of high blood cholesterol levels in the adult population, a considerable number of adults have a high serum lipid concentration (desirable blood cholesterol is <200 mg/dL, borderline high blood cholesterol is 200–239 mg/dL, and high blood cholesterol is ≥240 mg/dL).[15,16] A study conducted among urban Asian Indians indicated a substantial gap in awareness, treatment, and control for hypercholesterolemia in India.[5] There is a paucity of community-based studies on hypercholesterolemia among the adult population of India. With this background, the present study was conducted with the aim of assessing the prevalence and spectrum of hypercholesterolemia along with its associated factors among adult (aged 30–59 years) residents of the urban areas of the Prayagraj district (Uttar Pradesh, India).

METHODS

Before the commencement of the study, ethical approval was obtained from the Institutional Ethics Review Board (IERB), University of Allahabad, Prayagraj (vide letter no IERB ID: FAM-D-21-001 dated March 17, 2021). The subjects were briefed about the study and were informed that their participation was voluntary in the study. Informed written consent was obtained from the subjects regarding their participation in the study and the use of data for research and educational purposes. The procedures used followed the guidelines laid down in the Declaration of Helsinki.

A cross-sectional study design was adopted for this study, which was undertaken in the urban areas of Prayagraj. The estimated population of urban Prayagraj in 2024 is 13.5 Lacs.[17] This district has a total of 8 subdistricts and 80 census-enumerated wards. The reference population for this study was urban adults aged 30–59 years who were residing in Prayagraj**.**

A pilot study was conducted in a similar age group (30–59 years) from a non-study area, from which the prevalence of hypercholesterolemia (30%) was obtained. Taking the prevalence of hypercholesterolemia as 30%, permissible level of error as 5%, design effect as 1.5, and nonresponse rate as 10%, the sample size of 538 was selected. However, the study was conducted on 536 subjects due to nonresponse from 2 subjects. A multistage sampling procedure was adopted for the selection of subjects. Zone, census enumeration wards, households, and family were the variables for selecting the subjects. The following steps were taken when selecting the study subjects. First out of five zones of urban Prayagraj, two were selected randomly. From each zone, one census-enumerated ward was selected randomly. Second, in these two wards, households were selected according to the probability proportion to size by adopting a systematic random sampling technique. Third, one family from the selected households was randomly selected using the lottery method. Fourth, one study subject aged 30–39 years was randomly identified from a selected family using the lottery method. Of the selected subjects (aged 30–39 years), those consenting to the study were considered to be study subjects, and those with terminal illnesses or serious mental abnormalities were excluded.

Information about the subjects' sociodemographic characteristics and dietary habits were obtained by interviewing subjects (30–59 years) by the researcher using a predesigned and pretested interview schedule. The predesigned interview schedule was field-tested in a non-study area for consistency, duplication, and redundancy. Sub-sections of the interview schedule were sociodemographic variables (e.g., age, gender, marital status, religion, caste, education, occupation, type of family, size of family, and socioeconomic status), information regarding nutritional parameters (e.g., height, weight, waist circumference, body fat%, visceral fat%, food habit, and fast-food consumption), and the cholesterol level of the subjects.

The educational status of the subjects was classified as illiterate (those who cannot read and write), just literate (those who can both read and write in any language), primary (5th standard), secondary (8th standard), high school (10th standard), and intermediate (12th standard) levels. Graduation and above were considered tertiary education.

The subjects were classified based on their family type (joint or nuclear). A joint family typically consists of more than one married couple and their children who live together in the same household. All the men in such families are related by blood, and the women of the household are their wives, unmarried girls, and widows. All the properties are held in common. A nuclear family consists of a married couple and their children who are dependent on the couple.[18]

Kuppuswamy's Socioeconomic Status scale was used to categorize the socioeconomic status of the subjects. This score-based scale is widely used in India for the categorization of the socioeconomic status of subjects living in urban areas. Information on the education of the head of the family, the occupation of the head of the family, and the total monthly family income with their score were recorded to classify the subject's socioeconomic status as upper (26–29), upper-middle (16–25), lower-middle (11–15), upper lower (5–10), and lower (<5).[19]

The Omron HBF-224 Body Composition Monitor Machine (noninvasive) was used for recording the weight, visceral fat%, and body fat% of the subjects. The height of the subjects was recorded using a stadiometer, whereas flexible, nonstretchable tape was used to measure the waist circumference of the subjects following standard techniques. All anthropometric assessments were performed by the researcher.

The nutritional status of the subjects was assessed in terms of the body mass index (BMI). Based on the ratio of weight (kg) and square of height (m^2), the subjects were classified as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (>30.0 kg/m^2) as per the World Health Organization (WHO) criteria.[20] The waist circumference of the subjects was assessed, and the subjects were classified as normal (men: <90 cm, women: <80 cm) and at risk (men: ≥90 cm, women: ≥80 cm) using the WHO classification.[20] The body fat_percentage was calculated by determining how much of a subject's weight is fat. Body fat% was classified as low (men 5.0–9.9%, women 5.0–19.9%), normal (men: 10.0–19.9% and women: 20.0–29.9%), high (men: 20.0–24.9% and women: 30.0–34.9%), and very high (men: >25.0% and women: >35%). Visceral fat is also known as organ fat or intraabdominal fat. It is located inside the abdominal cavity, packed between the organs such as around the stomach, liver, intestines, and kidneys. Visceral fat% was classified as normal (1–9), high (10–14), and very high (15–30.0).[21,22]

For the estimation of the total serum cholesterol level, a venous blood sample (5 ml) was collected. Blood collection of the subjects was performed in the morning on an empty stomach (8–12 hours of fasting) by a trained technician following an aseptic procedure. The blood sample was collected in plain tubes containing sodium fluoride and ammonium oxalate and promptly processed within 1 h of collection at the Private National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory. Blood samples were centrifuged to obtain serum. The standard spectrophotometry-esterase/CO/peroxidase enzymatic method was employed to ascertain hypercholesterolemia among the subjects.[23]

Hypercholesterolemia and its spectrum were decided by setting the cut-off level of total cholesterol for the adult population as proposed by the NCEP (2001). Based on the cholesterol level, a subject was considered to have hypercholesterolemia when the cholesterol level was ≥200 mg/dL; the subjects were categorized as normal (<200 mg/dL), borderline (200–239 mg/dL), or high risk (≥240 mg/dL).[16]

For data analysis, the Statistical Package for Social Sciences (SPSS 21st version) was used. To determine the associations of hypercholesterolemia with sociodemographic (e.g., age, gender, marital status, caste, religion, education, occupation, family type, family size, and socioeconomic status) and nutritional parameters (e.g., BMI, waist circumference, body fat%, visceral fat%, food habit, and fast food consumption), chi-square test was applied, and $p < 0.05$ was considered to indicate statistical significance. All significant variables (age, family size, BMI, waist circumference, and visceral fat%) were included in the logistic regression analysis. Adjusted odds ratios (AORs) and 95% confidence interval (CI) were computed to pinpoint the predictors of hypercholesterolemia.

RESULTS

In this study, subjects aged 30–59 years were selected using a multistage procedure from the urban Prayagraj area based on their meeting the inclusion and exclusion criteria. Descriptive data collected pertained to sociodemographic and socioeconomic variables. Of the 536 subjects, 55.2% were male, 89.0% were married, 97.4% followed the Hindu religion, and 56.3% were from the other caste categories, whereas 33.2% and 46.5% of subjects had completed graduation and post-graduation and above, respectively. Nearly 60% of subjects were involved in service. In accordance with the Kuppuswamy Socioeconomic Status in 14.6%, 68.5%, and 17.0% subjects, the Socioeconomic status was upper, upper-middle, and lower-middle to lower, respectively. In this study, the primary outcome variable was the prevalence of hypercholesterolemia in urban adults (30–59 years) residing in Prayagraj, India. Its spectrum, associates, and predictors were the key findings of the study.

The prevalence of hypercholesterolemia in the study subjects was 24.4%; in the cases of 20% and 4.4%, the subjects' cholesterol levels were borderline (200–239 mg/dL) and high-risk (≥240 mg/dL) categories, respectively. Among all sociodemographic variables (e.g., age, gender, education, religion, marital status, caste, occupation, family type, family size, and socioeconomic status), age and family size were significantly associated with hypercholesterolemia. As much as 14%, 29.1%, and 33.5% of subjects aged 30–39, 40–49, and 50–59 years had hypercholesterolemia, respectively. Out of 344 subjects with a family size of 2–4, 27.6% had hypercholesterolemia; the corresponding value for subjects with a family size of ≥5 was 18.8%. Gender, marital status, religion, caste, education, occupation, type of family, and socioeconomic status of the subjects were not significantly associated with hypercholesterolemia (Table 1).

The association of hypercholesterolemia in the study subjects with their nutritional parameters is given in Table 1. BMI, waist circumference, and visceral fat were significantly associated with hypercholesterolemia. The association of body fat and food habits with hypercholesterolemia was not significant. As much as 8.3%, 19.5%, and 28.1% of the underweight, normal weight, and overweight and obese subjects had hypercholesterolemia, respectively.

TABLE 1. Independent variables associated with hypercholesterolemia

Variables	Overall (N = 536)	Normal (N = 405) N (%)	Hypercholesterolemic (N = 131) N (%)	*p*
Age				
30–39	214	184 (86)	30 (14.0)	<0.001
40–49	158	112 (70.9)	46 (29.1)	
50–59	164	109 (66.5)	55 (33.5)	
Sex				
Male	296	220 (74.3)	76 (25.7)	>0.05
Female	240	185 (77.1)	55 (22.9)	
Marital status				
Unmarried	38	31 (81.6)	7 (18.4)	>0.05
Married	477	359 (75.3)	118 (24.7)	
Without Spouse	21	15 (71.4)	6 (28.6)	
Religion				
Hindu	522	395 (75.7)	127 (24.3)	>0.05
Muslim + Christian	14	10 (71.4)	4 (28.6)	
Caste				
SC/ST	83	64 (77.1)	19 (22.9)	>0.05
OBC	151	120 (79.5)	31 (20.5)	
Other	302	221 (73.2)	81 (26.8)	
Education				
Illiterate + Just literate + Primary + Secondary	48	42 (87.5)	6 (12.5)	>0.05
High school + Intermediate	61	46 (75.4)	15 (25.6)	
Graduation	178	135 (75.8)	43 (24.2)	
Post-graduation + Ph.D. D	249	182 (73.1)	67 (26.9)	
Occupation				
Service	317	241 (76.0)	76.0 (24.0)	>0.05
Business	63	45 (71.4)	18 (28.6)	
Skilled worker/labor	22	17 (77.3)	5 (22.7)	
Homemaker	121	92 (76.0)	29 (24.0)	
Unemployed	13	10 (76.9)	3 (23.1)	
Family type				
Nuclear	348	259 (74.4)	89 (25.6)	>0.05
Joint family	188	146 (77.7)	42 (22.3)	
Family size				
2–4	344	249 (72.4)	95 (27.6)	<0.001
≥5	192	156 (81.3)	36 (18.8)	
Socioeconomic status				
Upper	78	55 (70.5)	23 (29.5)	>0.05
Upper-middle	367	275 (74.9)	92 (25.1)	
Lower-middle	46	38 (82.6)	8 (17.4)	
Upper lower + Lower class	45	37 (82.2)	8 (17.8)	
Body Mass Index				
Under weight	12	11 (91.7)	1 (8.3)	<0.05
Normal	200	161 (80.5)	39 (19.5)	
Overweight + Obese	324	233 (71.9)	91 (28.1)	
Waist circumference				
Normal	257	205 (79.8)	52 (20.2)	<0.05
At Risk	279	200 (71.7)	79 (28.3)	
Visceral fat %				
Normal	189	156 (82.5)	33 (17.5)	<0.05
High	211	151 (71.6)	60 (28.4)	
Very high	136	98 (72.1)	38 (27.9)	
Body fat %				
Normal	51	43 (84.3)	8 (15.7)	>0.05
High	485	362 (74.6)	123 (25.4)	
Food habit				
Vegetarian	284	211 (74.3)	73 (25.7)	>0.05
Non-vegetarian	252	194 (77)	58 (23.0)	

TABLE 2. Logistic regression analysis of hypercholesterolemia and its possible predictors

Particulars	Estimation of β	Standard Error of β	*p*	AOR	95% CI	
					Lower	Upper
Age groups (Years)						
30–39 Ref						
40–49	1.067	0.270	0.000	2.91	1.71	4.93
50–59	0.862	0.270	0.001	2.37	1.39	4.02
Family size						
≥5 Ref						
2–4	0.416	0.228	0.068	1.51	0.97	2.37
Body Mass Index						
Underweight Ref						
Normal	0.794	1.080	0.462	2.21	0.27	18.37
Overweight/obese	1.050	1.106	0.343	2.86	0.33	24.99
Waist Circumference						
Normal Ref						
At risk	0.173	0.255	0.497	1.19	0.72	1.96
Visceral fat %						
Normal Ref						
High	0.253	0.307	0.410	1.29	0.71	2.35
Very high	−0.034	0.378	0.929	0.97	0.46	2.03

Out of 257 subjects with normal waist circumference, 20.2% had hypercholesterolemia, whereas out of 279 subjects with at-risk waist circumference, 28.3% had hypercholesterolemia. Subjects with high (28.4%) and very high (27.9%) visceral fat were more at risk of hypercholesterolemia. Although the consumption of fast food by subjects was not significantly ($p > 0.05$) associated with hypercholesterolemia, it was high among subjects consuming fast food (45.1%).

Findings of the logistic regression analysis between hypercholesterolemia and its possible predictors are given in Table 2. Considering 30–39 years of age group as a reference, the AOR for hypercholesterolemia was 2.91 (95% CI: 1.71–4.93) and 2.37 (95% CI: 1.39–4.02) among subjects of ages 40–49 years and 50–59 years, respectively. Compared to subjects with a family size of ≥5, higher AOR (1.51; 95%CI: 0.97–2.37) was obtained for subjects with a family size of 2–4. Higher AORs for hypercholesterolemia were obtained for overweight/obese (2.86; 95% CI: 0.33–24.99), normal nutritional status (2.21; 95% CI: 0.27–18.37), at-risk subjects on the basis of waist circumference (1.19; 95% CI: 0.72–1.96), very high visceral fat (0.97; 95% CI: 0.46–2.03), and high visceral fat (1.29; 95% CI: 0.71–2.35). Significant association was noted for the age, family size, BMI, waist circumference, and visceral fat (Table 1). In logistic regression analysis, only age remained a significant predictor of hypercholesterolemia (Table 2). The overall percentage of correct prediction through logistic regression was 75.6%.

DISCUSSION

In this study, one out of four subjects had hypercholesterolemia. A lower prevalence of hypercholesterolemia was reported in studies conducted outside India. Nearly 1 out of 14 Chinese subjects had hypercholesterolemia.[24] In contrast to the present finding, a higher prevalence of hypercholesterolemia was reported in Pakistan (2 out of 7)[25] and subjects from Samara City, Iran (11 out of 20).[26] A lower prevalence of hypercholesterolemia has been reported in Indian studies. According to a study conducted across four states of India (e.g., Tamil Nadu, Maharashtra, Jharkhand, and Chandigarh), nearly one out of seven subjects had hypercholesterolemia with the maximum rate of hypercholesterolemia (2 out of 11) in Tamil Nadu.[4]

In another study conducted in the state of Gujrat, 3 out of 22 subjects had hypercholesterolemia.[27] The prevalence of hypercholesterolemia has reportedly been higher in relevant literature than in the present study. For instance, studies conducted in North Kerala and Punjab reported that 5 out of 8 and 3 out of 8 had hypercholesterolemia, respectively,[28,29] and nearly 2 out of 3 subjects in west Uttar Pradesh[30] had hypercholesterolemia. A study conducted in the urban and rural areas of south India also revealed a marginally higher prevalence of hypercholesterolemia in the urban area (3 out of 10) than in the rural areas (1 out of 4).[31] Variations in the prevalence of hypercholesterolemia in the studies under reference may be attributed to the differences in the settings, contextual factors, and time framework.

A higher prevalence of hypercholesterolemia has been observed in urban areas than rural areas, possibly due to the differences in socioeconomic status, occupation, lifestyle, and high availability of fast-food outlets. The study done in low-middle-income countries reported that subjects living in slum areas have poor socioeconomic status and poor living conditions, which increases their risk of poor health.[32] Subjects living in urban areas are mostly sedentary workers who generally indulge in fewer physical activities than subjects working as manual laborers in rural areas. The frequency of fast and Western food consumption is often more common among urban subjects, potentially contributing to their unfavorable blood lipid levels.[33,34]

In this study, an attempt was made to include possible variables associated directly or indirectly with hypercholesterolemia based on a literature search. Although in the subcategories of variables (e.g., gender, marital status, religion, caste, education, occupation, family type, and socioeconomic status), differences in the prevalence of hypercholesterolemia prevailed, albeit such differences were not statistically significant. This is possibly due to similar prevailing lifestyle practices across subgroups in the urban setting. In this study, hypercholesterolemia was more common among male (nearly 1 out of 4) than among female (3 out of 13) subjects. A similar finding has been reported in a study from Saudi.[35] In this study, nearly 1 out of 7, 29 out of 100, and 17 out of 50 subjects aged 30–39, 40–49, and 50–59 years, respectively, had hypercholesterolemia. In consonance with the present finding, an increasing trend of hypercholesterolemia with increasing age was reported in the ICMR-INDIAB study.[4] A study from outside of India (Pakistan) also reported that hypercholesterolemia significantly increased with age.[25] As many as 7 out of 25 and 1 out of 6 subjects with family sizes of 2–4 and ≥5, respectively, had hypercholesterolemia. Besides other lifestyle issues, there is a possibility of transitioning from the traditional to the Western diet.

Except for body fat, all nutritional parameters (e.g., BMI, waist circumference, visceral fat%) were significantly associated with hypercholesterolemia. One out of 13 underweight, 5 out of 13 normal, and 7 out of 25 overweight + obese subjects had hypercholesterolemia. Studies from China and Thailand also reported a significant positive correlation with the total cholesterol and BMI (25–29.9 kg/m^2).[24,36] A study conducted on urban Asian Indians reported a significant association of BMI with their total cholesterol level. Subjects with high BMI were at risk of hypercholesterolemia.[13] A study conducted by the Indian Council of Medical Research- India Diabetes (ICMR-INDIAB Study) in the states of India (e.g., Tamil Nadu, Maharashtra, Jharkhand, and Chandigarh) reported significantly higher BMI with some lipid abnormality.[4] Another study conducted on Iraqi adults revealed that hypercholesterolemia was more frequent among those with a BMI ≥25 compared to those with a BMI < 25, albeit without any significant association.[22]

Subjects with at-risk waist circumference were more hypercholesterolemic than those with normal waist circumference. Nearly 7 out of 25 subjects with at-risk waist circumference had hypercholesterolemia. Similar to the present finding, a study conducted among urban Asians revealed a significant association between high waist circumference and hypercholesterolemia.[13] The ICMR-INDIAB study conducted in the four states of India (e.g., Tamil Nadu, Maharashtra, Jharkhand, and Chandigarh) reported significantly higher waist circumference with some lipid abnormality.[4]

It is to be noted that nearly one out of five subjects with normal BMI and normal waist circumference had hypercholesterolemia. In consonance with this finding, a study reported that one out of six subjects with a normal BMI had hypercholesterolemia.[37] Considering the cross-sectional nature of this study, we may not have captured the temporality of risk factors and disease occurrence in a considerable number of cases as the factor precedes the disease.

As many as 9 out of 50 and 7 out of 25 subjects with normal and high/very high visceral fat had hypercholesterolemia. A significant association existed between visceral fat and hypercholesterolemia. In contrast to the present findings, no significant difference was reported between the total cholesterol and visceral fat ratings of the subjects from Thailand.[36] However, a study conducted in the non-diabetic Chinese population reported a positive correlation with their LDL-cholesterol levels.[38] Nine out of 20 subjects consuming fast food had hypercholesterolemia in contrast to one out of four subjects cases in the present study. The present findings highlight the issues of lifestyle modification in small-sized families. There is a need to regulate BMI, waist circumference, and visceral fat to minimize the risk of hypercholesterolemia. Among all these parameters, the influence of BMI and Waist Circumference has been explored in the past. The linkage of visceral fat and hypercholesterolemia revealed in this study calls for a total fat reduction as visceral fat is more strongly correlated with ill health. Through logistic regression analysis, age remained a significant predictor of hypercholesterolemia, with a prediction accuracy of 75.4%.

This study makes a significant contribution to scientific advancement by fulfilling the prevailing hypercholesterolemia gap in eastern Uttar Pradesh, India. The study has significant policy implications as it provides significant inputs for strategic reforms in preventive and promotive initiatives for reducing hypercholesterolemia among urban adults. The findings of the study can be generalized to adult subjects only who are living in an urban setting, as subjects residing in rural areas were not included in the study. The cross-sectional approach is one of the limitations of this study; therefore, a causal relationship could not be established. A prospective study on this issue is needed to fill the information gap. There might have been an information gap in the assessment of socio-economic status as the information on total family income was obtained from a family member. It is worthwhile to examine the linkages of various significant factors in hypercholesterolemia, giving due consideration to factor-specific sample size.

CONCLUSIONS

One out of four urban subjects of the age group 30–59 years had hypercholesterolemia. Advancing age (50–59 years), family size (2–4), BMI (>25 kg/m^2), at-risk waist circumference, and very high visceral fat%) were significantly associated with this condition. This finding calls for targeted intervention to reduce total cholesterol levels by prioritizing actions for at-risk groups in general and the aging groups in particular.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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REFERENCES

1. GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2015;385:117–71.
2. Jung E, Kong SY, Ro YS, Ryu HH, Shin SD. Serum cholesterol levels and risk of cardiovascular death: A systematic review and a dose-response meta-analysis of prospective cohort studies. *Int J Environ Res Public Health*. 2022;19:8272.
3. Chandra KS, Bansal M, Nair T, Iyengar SS, Gupta R, Manchanda SC, et al. Consensus statement on management of dyslipidemia in Indian subjects. *Indian Heart J*. 2014;66 Suppl 3:S1–51.
4. Joshi SR, Anjana RM, Deepa M, Pradeepa R, Bhansali A, Dhandania VK, et al. Prevalence of dyslipidemia in urban and rural India: The ICMR-INDIAB study. *PLoS One*. 2014;9:e96808.
5. Gupta R, Rao RS, Misra A, Sharma SK. Recent trends in epidemiology of dyslipidemias in India. *Indian Heart J*. 2017;69:382–92.
6. Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2019;73:3168–209.
7. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart Disease and Stroke Statistics-2018 Update: A Report From the American Heart Association. *Circulation*. 2018;137:e67–492.
8. Adeloye D, Abaa DQ, Owolabi EO, Ale BM, Mpazanje RG, Dewan MT, et al. Prevalence of hypercholesterolemia in Nigeria: A systematic review and meta-analysis. *Public Health*. 2020;178:167–78.
9. Reddy KS, Prabhakaran D, Chaturvedi V, Jeemon P, Thankappan KR, Ramakrishnan L, et al. Methods for establishing a surveillance system for cardiovascular diseases in Indian industrial populations. *Bull World Health Organ*. 2006;84:461–9.
10. Kinra S, Bowen LJ, Lyngdoh T, Prabhakaran D, Reddy KS, Ramakrishnan L, et al. Sociodemographic patterning of non-communicable disease risk factors in rural India: A cross sectional study. *BMJ*. 2010;341:c4974.
11. Pandey RM, Gupta R, Misra A, Misra P, Singh V, Agrawal A, et al. Determinants of urban-rural differences in cardiovascular risk factors in middle-aged women in India: A cross-sectional study. *Int J Cardiol*. 2013;163:157–62.
12. Shah B, Mathur P. Surveillance of cardiovascular disease risk factors in India: The need & scope. *Indian J Med Res*. 2010;132:634–42.
13. Guptha S, Gupta R, Deedwania P, Bhansali A, Maheshwari A, Gupta A, et al. Cholesterol lipoproteins and prevalence of dyslipidemias in urban Asian Indians: A cross sectional study. *Indian Heart J*. 2014;66:280–8.
14. Majhi MM, Mishra CP, Mishra SP. Elevated blood triglycerides and its predictors in rural adult population: Findings from central India. Int J Sci Res. 2019;8:56–8.
15. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). *JAMA*. 2001;285:2486–97.
16. Goodman DS. The National Cholesterol Education Program: Guidelines, status, and issues. *Am J Med*. 1991;90:32S–35.
17. FindEasy. *Uttar Pradesh Population 2024*. India: FindEasy, 2021.
18. Park K. *Park's textbook of preventive and social medicine*. 27th ed. Madhya Pradesh, India: Banarsidas Bhanot; 2023.
19. Ananthan VA. Modified Kuppuswamy scale for socioeconomic status of the Indian family- Update based on New CPI (IW) series from September 2020. *J Family Med Prim Care*. 2021;10:2048–9.
20. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. *World Health Organ Tech Rep Ser*. 2000;894:i–xii, 1–253.
21. Nagamine S. Diagnosis of obesity from subcutaneous fat deposition. *J Japan Med Assoc*. 1972;68:919.
22. Lohmann TG, Roche AF, Martorell R. *Anthropometric Standardization Reference Manual*. Champaign, IL, USA: Human Kinetics Books; 1988.
23. Li LH, Dutkiewicz EP, Huang YC, Zhou HB, Hsu CC. Analytical methods for cholesterol quantification. *J Food Drug Anal*. 2019;27:375–86.
24. Zhang M, Wang LM, Chen ZH, Zhao ZP, Li YC, Deng Q, et al. 2013 年中国不同区域成人高胆固醇血症流行水平及相关因素分析 [Multilevel logistic regression analysis on hypercholesterolemia related risk factors among adults

in China]. *Zhonghua Yu Fang Yi Xue Za Zhi*. 2018;52:151–7. Chinese.
25. Sarfraz M, Sajid S, Ashraf MA. Prevalence and pattern of dyslipidemia in hyperglycemic patients and its associated factors among Pakistani population. *Saudi J Biol Sci*. 2016;23:761–6.
26. Al-Mahmood AAS, Al-Sharifi EAH, Al-Mahmood AAA. Epidemiology of hypercholesterolemia among adults in Samara City. *Indian J Public Health Res Dev*. 2020;11:909–14.
27. Gamit DN, Mishra A. A lipid profile study amongst the patients of type 2 diabetes mellitus – A cross sectional study. *Int Arch Integr Med*. 2018;5:1–5.
28. Aslesh OP, Jayasree AK, Karunakaran U, Venugopalan AK, Divakaran B, Mayamol TR, et al. Prevalence of hypercholesterolaemia among adults aged over 30 years in a rural area of north Kerala, India: A cross-sectional study. *WHO South East Asia J Public Health*. 2016;5:70–5.
29. Bali K, Vij AS. Pattern of dyslipidemia in type 2 diabetes mellitus in Punjab. *Int J Res Med Sci*. 2016;4:809–12.
30. Singh Y, Vohra DK, Khan MM, Singh G. Prevalence of dyslipidemia in newly diagnosed patients of type-2 diabetes mellitus at tertiary care centre of West Uttar Pradesh: A single centre study. *Panacea J Med Sci*. 2019;9:33–6.
31. Raj SA, Sivakumar K, Sujatha K. Prevalence of dyslipidemia in South Indian adults: An urban-rural comparison. *Int J Community Med Public Health*. 2016;3:2201–10.
32. United Nations. *The Millennium Development Goals Report 2014*. New York, United States: United Nations, 2014.
33. United Nations. *World urbanization prospects: The 2014 revision*. New York, United States: United Nations, 2015.
34. Patil RR. Urbanization as a determinant of health: A socioepidemiological perspective. *Soc Work Public Health*. 2014;29:335–41.
35. Al-Hassan YT, Fabella EL. Lipid profile analysis of patients in a Saudi university clinic. *World J Public Health*. 2017;2:89–95.
36. Sukkriang N, Chanprasertpinyo W, Wattanapisit A, Punsawad C, Thamrongrat N, Sangpoom S. Correlation of body visceral fat rating with serum lipid profile and fasting blood sugar in obese adults using a noninvasive machine. *Heliyon*. 2021;7:e06264.
37. Ranganathan S, Krishnan T, Radhakrishnan S. Comparison of dyslipidemia among the normal-BMI and high-BMI group of people of rural Tamil Nadu. *Med J Dr. DY Patil Univ*. 2015;8:149–52.
38. Luo Y, Ma X, Shen Y, Hao Y, Hu Y, Xiao Y, et al. Positive relationship between serum low-density lipoprotein cholesterol levels and visceral fat in a Chinese nondiabetic population. *PLoS One*. 2014;9:e112715.