ORIGINAL RESEARCH ARTICLE
pISSN 0976 3325 | eISSN 2229 6816
Open Access Article
www.njcmindia.org
DOI: 10.5455/njcm.20200806035409

Inequality of Chronic Non-Communicable Diseases Across Various Wealth Groups of India: Results from Latest Cross-Sectional Survey

Mustafa Akif[1], Ansari Salman[2]

Financial Support: None declared
Conflict of Interest: None declared

How to cite this article:
Akif M, Salman A. Inequality of Chronic Non-Communicable Diseases Across Various Wealth Groups Of India: Results From Latest Cross Sectional Survey. Natl J Community Med 2020; 11(11): 413-420

Author's Affiliation:
[1]Research Fellow, International Institute for Population Science, Mumbai; [2]Research Fellow, International Institute for Population Science, Mumbai

Correspondence
Akif Mustafa
akifalig25@gmail.com

Date of Submission: 06-08-2020
Date of Acceptance: 20-11-2020
Date of Publication: 30-11-2020

ABSTRACT

Background: Non-communicable diseases are the major contributor to mortality and morbidity all over the world including India. About 60% (5.87 million) of all deaths in India are attributed to NCDs. In the present study we have tried to analyze the socioeconomic inequality in the prevalence of the selected four NCDs (Diabetes, Hypertension, Thyroid disorder and Obesity) among the Indian population while paying special attention to urban rural differentials.

Data and Methods: The data of NFHS-4 (2015-16), were used for the present study. To find out the level of inequalities concentration curve and its associated concentration index (CI) were calculated for the selected NCDs. For further clarification odds ratios were calculated using binary logistic regression.

Results: Socioeconomic inequalities were found in the prevalence of all the four selected NCDs. According to the values of CI, highest inequality was in the prevalence of obesity (CI=0.44, p=0.00) and lowest for hypertension (CI=0.06, p=0.00). The values of CI and odds ratios for rural and urban areas are depicting that in both the areas the NCDs are disproportionately concentrated among the rich population.

Conclusion: There is a need of potential target based approach to fight against NCDs keeping the high risk groups in mind.

Keywords: Non-Communicable Diseases, India, Inequality, NFHS-4, Diabetes, Obesity

INTRODUCTION

Non-communicable diseases are the major contributor to mortality and morbidity all over the world. According to WHO 41 million deaths, each year are contributed by NCDs, accounting for 71% of all global deaths [1]. The global burden of disease study shows that 21 out of 30 leading causes of years lived with disability (YLDs) are contributed by NCDs [2].

As India is passing through both demographic and epidemiological transition, there is a shift from communicable diseases to non-communicable diseases and the burden of NCDs has increased at a significant pace in past few decades. According to the 4th National Family Health Survey (NFHS-4), the prevalence of diabetes almost doubled in the past years and the prevalence of hypertension and pre-hypertension was found to be 11% and 30.3% [3]. Overweight and Obesity is a major risk factor of various non-communicable diseases [4] and its prevalence increased from 12.6% in 2005-06 to 20.7% in 2015-16 [8]. The report published by the Indian Council of Medical Research titled: Health of the Nation's States: The India State-Level Disease Burden Initiative (2017) illustrated that between 1990 to 2016, in the span of 26 years the burden of NCDs increased from 30% to 55% [5]. Thus, the trend of

NCDs in India has experienced a major change over the last 15 years, especially in low socio-economic classes.

In past years many attempts had been made to find out the relationship between NCDs and socioeconomic characteristics. A WHO report stated that the poor may be more vulnerable to NCDs because of various reasons, like economic and material scarcity, lack of resources, psychological distress, high-risk behaviors, unhealthy and unhygienic living conditions, etc.[6]. Many risk factors of NCDs like tobacco use, alcohol consumption, consumption of unhealthy food and unhygienic conditions are more prevalent in the stratum with low socioeconomic stratum[7]. A past study shows that NCDs are disproportionately associated with socioeconomic groups [8].

In 2015 India signed the declaration on the 2030 agenda for sustainable development goals, which includes reduced inequalities as one of its goals. Therefore in the present study, we have tried to map the socioeconomic disparities and inequalities in the prevalence of four selected NCDs (Diabetes, Hypertension, Thyroid disorder, Obesity) in India.

METHODOLOGY

The data of the fourth iteration of the National Family Health Survey (NFHS-4) which was conducted in 2015-2016, were used for the present study [3]. NFHS is an Indian version of the Demographic Health Survey (DHS). It is an important source of data used to produce information for policy and program purposes, to inform the Ministry of Health and Family Welfare and other organizations. NFHS provides information on various subjects like domestic violence, sanitation, fertility, mortality, morbidity, nutrition, amenities, women empowerment, etc. The survey, for the first time, covered all 640 districts across 36 states and union territories by the government of India under the stewardship of the ministry of health and family welfare (MoHFW) (IIPS, 2017). A representative sample of households was collected using a two-stage stratified design of samples. First, primary sampling units (hereafter referred to as clusters) were chosen within each district, based on a 2011 Census sampling frame. The clusters corresponded to villages in rural areas. Clusters in urban areas corresponded to the blocks of the census enumeration. A full procedure of household mapping and listing within each cluster was performed. Houses were chosen at the second stage of sampling using systematic sampling with probability proportional to the size. The survey data was collected from 699686 women aged 15-49 and 112122 men aged 15-54, total 601509 households were visited which were selected from 28583 primary sampling units (PSUs). Four questionnaires (Biomarker, Household, Man's and Woman's) were used for data collection in the survey. The response rate among men was 92% and among women, it was 97%. A comprehensive description of the process and methodology is described in the NFHS-4 report [3].

Measurement of NCDs

In the present study, we have taken 3 Major NCDs Diabetes Hypertension, and Thyroid disorder to estimate socioeconomic inequalities. We have also included Obesity in the study, which is a major risk factor of various NCDs and categorized as a disorder in ICD classification. The information was collected by trained staff with the help of modern measurement tools. The Seca 874 digital scale was used to measure the weight of children and adults. Body Mass Index (BMI) was calculated to find out overweight/obesity, As suggested by WHO respondents having BMI between 25 to 29.9 were considered overweight and respondents with BMI greater than 30 were considered obese and respondents with less than 25 BMI were considered normal (including underweight) [9]. To find out the prevalence of hypertension Blood Pressure was measured from eligible women aged 15-49 and eligible men aged 15-54, using an Omron Blood Pressure Monitor. A respondent was classified as hypertensive if he/she had a systolic blood pressure level greater than or equal to 140 mmHg or diastolic blood pressure greater than or equal to 90 mmHg, or he/she is taking any antihypertensive medication [10], [3]. The data on diabetes and thyroid disorder was collected based on a direct question regarding the disease that whether they are suffering from the disease or not, so the prevalence (for the present study) thyroid disorder and diabetes was calculated on the basis of self-reporting.

Measurement of socioeconomic status and inequality

For the representation of socioeconomic status (SES) data on the wealth index were used which was collected in NFHS-4. The wealth index was calculated based on some parameters like income, ownership of some selected assets, etc. On the basis of ownership of wealth index, the population was divided into 5 groups: poorest, poorer, middle, richer and richest [3].

Data Analysis

To show the inequality in the prevalence of NCDs among the wealth quantiles concentration curve (CC) and related Concentration Index (CI) were calculated. The Concentration Curve is a curve having a cumulative proportion of the population ranked by SES on the x-axis and corresponding cumulative proportion of health variable on the y-

axis. The CI can be defined as twice the area between the line of equality and the concentration curve. The CI varies from -1 to +1. If the value of the index is zero it means, there is no SES related inequality. If the value of CI is negative it shows the increased concentration of health variables among people with low SES and the positive value of CI shows that the concentration of health variables is high among people with high SES.

For further clarification adjusted odds ratios were calculated using multivariate binary logistic regression in Stata-15. The logistic model gives a relative likelihood of the occurrence of the event of interest. To compare the inequality between rural and urban areas the multivariate binary logistic regression was applied separately for rural, urban and total population. The logistic regression is a predictive analysis that is like regression analyses. Logistic regression assumes that the dependent variable is binary and there are no outliers in data. In logistic regression, input features are linearly scaled just as with linear regression; however, the result is then fed as an input to the logistic function. This logistic function is known as the sigmoid function. This function provides a nonlinear transformation on its input and ensures that the range of the output, which is interpreted as the probability of the input belonging the class 1, lies in the interval [0,1]. A simple form of logistic regression can be given as: logit [P(Y=1)] = ß0+ ß*X+ ε

The parameter ß0 estimates the log odds of having the non-communicable disease, while ß estimates the maximum likelihood, the differential log odds of the non-communicable disease associated with the set of predictors X, as compared to the reference group and ε represents the residuals in the model.

For data management and analysis, Stata version 15 was used. The raw data were transformed into grouped data and exported into excel for computation of concentration curves. The concentration indexes were calculated in Stata-15 using the command '*conindex*'. The associated concentration curves were made in excel using the technique suggested by world bank [11].

RESULTS

Table-1 is showing the socio-demographic characteristics of the sample population. Approximately 30 percent of the participants were from urban areas and 70 percent were from rural areas. Women aged 15-49 and men aged 15-54 were included in the sample. The participants were almost equally distributed among the five wealth quintiles. 26 percent of the participants were having no education and around 61 percent were having secondary or higher education.

Tables 1: Background characteristics of the sample population, NFHS-4

Variable	Frequency (n) (%)
Place of Residence	
Urban	240261 (29.6)
Rural	571547 (70.4)
Age Group	
15-19	143960 (17.73)
20-24	139585 (17.19)
25-29	131227 (16.16)
30-34	111688 (13.76)
35-39	104330 (12.85)
40-44	88581 (10.91)
45-49	83840 (10.33)
50-54	8597 (1.06)
Wealth Index	
poorest	151661 (18.68)
poorer	172686 (21.27)
middle	171499 (21.13)
richer	161885 (19.94)
richest	154077 (18.98)
Education	
no education	211564 (26.06)
primary	102641 (12.64)
secondary	400186 (49.3)
higher	97417 (12)

Table 2: Prevalence and concentration index of Diabetes, Hypertension, Thyroid disorder and Obesity by socioeconomic status among Indian population aged 15-55 years, NFHS-4

Wealth Index	Diabetes			Hypertension			Thyroid disorder			Obesity		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
poorest	1.62	0.8	0.84	11.08	9.97	10.03	1.09	0.66	0.68	1.33	0.47	0.64
poorer	1.16	0.96	0.99	10.31	10.39	10.38	1.33	1	1.04	2.22	1.28	1.37
middle	1.62	1.31	1.39	11.87	11.12	11.31	2.04	1.49	1.63	4.49	2.74	3.1
richer	2.57	2.04	2.3	13.25	12.74	13	2.71	2.09	2.4	7.17	4.98	5.67
richest	3.21	2.31	2.97	12.94	13.72	13.15	4.11	2.85	3.77	11.89	7.46	8.89
Total	2.6	1.3	1.75	12.65	11.12	11.65	3.1	1.36	1.96	8.91	2.96	4.8
Concentration Index	0.174	0.225	0.266	0.027	0.05	0.06	0.215	0.27	0.32	0.23	0.44	0.44
p value*	0	0	0	0	0	0	0	0	0	0	0	0
Standard error	0.008	0.007	0.0054	0.003	0.002	0.001	0.007	0.007	0.005	0.004	0.005	0.003

***based on z statistic**

Table 3: Results of Multivariate binary logistic regression, showing Adjusted odds ratios for selected NCDs by socioeconomic status stratified by place of residence, NFHS-4

NCDs	Urban		Rural		Total	
	OR	95% CI	OR	95% CI	OR	95% CI
Diabetes						
poorest ®					-	
poorer	0.81	0.6 - 1.1	1.15***	1.05 - 1.27	1.12**	1.02 - 1.23
middle	1.07	0.81 - 1.4	1.38***	1.26 - 1.5	1.36***	1.25 - 1.48
richer	1.4**	1.08 - 1.81	1.9***	1.74 - 2.1	1.84***	1.69 - 2.01
richest	1.5***	1.16 - 1.94	2.0***	1.8 - 2.2	1.96***	1.8 - 2.14
Hypertension						
poorest ®					-	
poorer	0.92	0.81 - 1.10	0.97	0.84 - 1.1	0.97	0.89 - 1.13
middle	0.94	0.83 - 108	0.89*	0.79 - 1.04	0.92	0.79 - 1.02
richer	0.91	0.79 - 1.03	0.87**	0.73 - 0.99	0.94	0.81 - 1.09
richest	0.88*	0.76 - 0.98	0.82***	0.70 - 0.93	0.89	0.73 - 1.07
Thyroid disorder						
poorest ®					-	
poorer	1.2	0.9 - 1.6	1.5***	1.40 - 1.68	1.5***	1.38 - 1.64
middle	1.64***	1.24 - 2.15	1.9***	1.74 - 2.07	1.8***	1.73 - 2.04
richer	2.0***	1.54 - 2.63	2.4***	2.24 - 2.68	2.38***	2.20 - 2.58
richest	2.7***	2.1 - 3.5	3.3***	3.0 - 3.66	3.25***	2.99 - 3.52
Obesity						
poorest ®						
poorer	1.7***	1.38 - 2.21	2.16***	2.0 - 2.37	2.2***	2.01 - 2.35
middle	3.06***	2.5 - 3.87	4.35***	4.05 - 4.7	4.6***	4.06 - 4.71
richer	4.9***	3.96 - 6.07	8.19***	7.51 - 8.7	7.6***	7.12 - 8.22
richest	7.7***	5.97 - 9.1	12.86***	11.57 - 13.55	11.2***	10.7 - 12.33

Note: ® Reference group; OR=Odds ratio
*** 'significant at 1% level of significance'; ** 'significant at 5% level of significance'; * 'significant at 10% level of significance'
Values without any star are not significant
The reported significance are based on 'p – values' which are based on 'z-statistic' are based on

It was found that the selected four NCDs diabetes, hypertension, thyroid disorder, and obesity were more prevalent among the rich population of India (Fig-1). When stratified by place of residence (urban, rural) we found similar kind of results, the prevalence of the selected NCDs were higher in the rich groups for both urban and rural areas. However, the level of inequality was higher in rural areas than in urban areas (Fig-2 and Fig-3).

The values of Prevalence and CI for diabetes, hypertension, thyroid disorder and obesity are presented in Table-2.

The overall prevalence of diabetes was 1.75%. The prevalence of diabetes (CI = 0.26, p = 0.00) was significantly higher in rich groups compared to the poor groups. When stratifying by place of residence we found that the level of inequality was higher in rural areas (CI = 0.225, p = 0.00) than urban areas (CI = 0.174. p = 0.00). However, the prevalence of diabetes was higher in urban areas (2.6%) than in rural areas (1.3%), (Table-1).

The overall prevalence of hypertension was 11.65%. The value of CI for hypertension (CI = 0.06) was low, which means that the prevalence of hypertension was slightly higher in the richest group (13.15%) than the poorest group (10.03%). The prevalence of hypertension in rural areas was 11.12% and in urban areas, it was 12.65% The value of CI for rural areas was 0.05 (p = 0.00) and for urban areas, it was 0.027 (p = 0.00).

The overall prevalence of thyroid disorders was found to be 1.96%. The prevalence of thyroid disorder (CI = 0.31, p=0.00) was more concentrated in rich strata of the population. The prevalence was highest in urban richest (4.11%) and lowest in rural poorest (0.66%). Though the prevalence of thyroid disorder was higher in urban areas (3.1%) than rural areas (1.36%), the inequality was higher in rural areas (CI = 0.27, p=0.00) than urban areas (CI = 0.21, p=0.00).

The overall prevalence of obesity was 4.8%. We found that obesity (CI = 0.44, p=0.00) was highly concentrated in the rich population. The prevalence of obesity was only 0.64% in the poorest group, on the other hand, it was 8.89% in the richest group.

The prevalence of obesity was much higher in urban areas (8.91%) than in rural areas (2.96%). Again, the level of inequality was higher in rural areas (CI = 0.44, p=0.00) than urban areas (CI = 0.23, p=0.00).

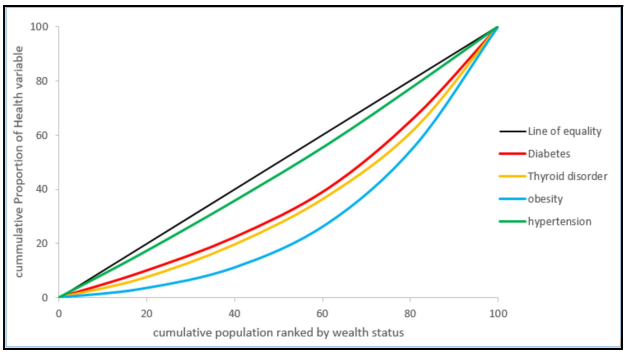

Figure 1: Concentration curve by health condition for total population, NFHS-4

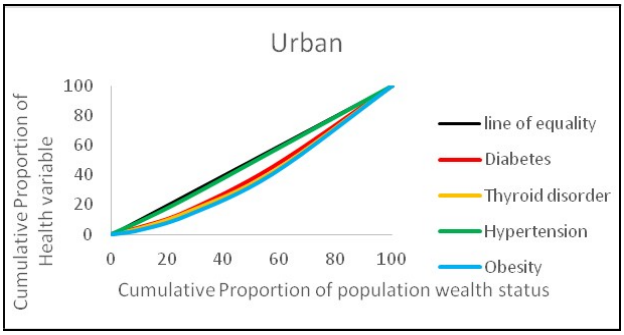

Figure 2: Concentration curve by health condition in urban areas, NFHS-4

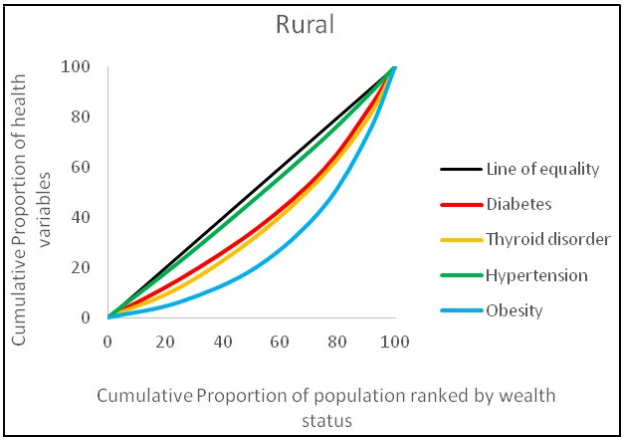

Figure 3: Concentration curve by health condition in rural areas, NFHS-4

Table-3 is showing the odds ratios. We can see that for all the selected NCDs the values of odds ratios increase as we move from the poorest group to the richest group, clearly depicting the higher risk of the NCDs in the rich groups. For diabetes, the OR was 1.96 (Confidence Interval (C.I.) = 1.8 – 2.14) for the richest group which is showing that the odds of having diabetes are 1.96 times more in the richest group than the poorest group. The OR for the richest group was 1.5 (C.I. = 1.16 – 1.94) in urban areas and 2.0 (C.I. = 2.12 – 3.39) in rural areas, it is plainly depicting that inequality is higher in rural areas. In the case of Hypertension almost all the odds ratios were coming out to be insignificant, for rural richest the OR was found to be 0.82 (C.I. = 0.7 – 0.93) showing that the odds of having hypertension were 18% less among rural richest that rural poorest. In the case of thyroid disorder, the OR for the richest group was found to be 3.25 (C.I. = 2.99 – 3.52), again the odds ratios were found to be of higher value for rural areas than urban area showing a higher level of inequality in rural areas. In the case of obesity, the OR for the richest group was 11.2 (C.I. = 10.7 – 12.33), showing that the risk of obesity is significantly very high in the rich stratum of the population (Table-3).

From Table-3 we can see that the values of OR are higher for the rural area than urban areas, which makes it clear that though the prevalence of the NCDs is higher in urban areas but the level of inequality in the prevalence of NCDs is higher in rural areas.

DISCUSSION

The present study assessed the prevalence and socioeconomic inequality of four chronic NCDs stratified by place of residence (urban, rural) in India using the data of nationally representative survey NFHS-4. The findings are clearly demonstrating that the NCDs are more prevalent among the rich people of India in both urban and rural areas. Likewise, the values of odds ratios are depicting that the risk of selected NCDs is significantly high among the rich groups compared to the poor groups. The relationship between health and socioeconomic status is very complex and shaped by the simultaneous effect of diverse social, political and economic factors[12,13]. These circumstantial and socioeconomic factors cause different-different levels of risk of the disease for different-different socioeconomic groups. On the basis of the aforementioned observations let's have a discussion on each of the selected NCD.

Diabetes

India is a huge country with around 1.3 billion population, and 22% of its population lives below the poverty line [14]. Previous researches show that significant inequality of health is prevalent in India. Life expectancy is a robust indicator of health, it is found that in India life expectancy is lowest (62.2 years) for men living in households with lowest wealth quintile in rural areas and highest (77 years) for women living in households with highest wealth quintile in urban areas showing the lack of equality in Indian society. There is an average gap of 7.6 years between people living in the high-

est wealth quintile and people living in the lowest wealth quintile [15]. NFHS-4 report depicts that infant mortality rate was 46.7 among the poorest and for richest it was 18.7 on the other hand obesity was more prevalent among people with high wealth index than people with low wealth index [3].

In our findings, we observed that diabetes was more prevalent among the rich in both urban and rural areas. Consistent with the present study there are various previous studies showing a positive association between diabetes and wealth, a study was done in 41 low and middle-income countries using the data of world health survey (2002-04) shows that the prevalence of diabetes was positively associated with increasing wealth quintile[8]. A study conducted in India found that the highest SES groups were at highest risk of diabetes[16]. A study conducted in the Dominican Republic found that diabetes was highly associated with affluence [17]. Metabolic syndrome and obesity are considered as the major risk factors of diabetes [18], [19], [20]. In the Indian context, the previous research shows that the risk of metabolic syndrome is positively associated with socioeconomic status[21], similarly, obesity is highly concentrated among the rich Indians [22],[3]. This high prevalence of these risk factors among the high socioeconomic groups of India could be one of the reasons for the high concentration of diabetes among the rich Indians. However, the present findings contradict the findings of some past studies conducted in higher-income countries [23], [24].

Hypertension

Hypertension is one of the major risk factors of almost all cardiovascular diseases [25]. In the present study, we found that the prevalence of hypertension was almost equally distributed among all wealth groups, there was a subtle urban-rural difference in the prevalence, however, the prevalence was slightly higher in urban areas. A study conducted in Bangladesh found that in urban areas hypertension was more prevalent among the rich and in rural areas it was more prevalent among the poor [26]. Though the prevalence of hypertension in India is lower than worldwide prevalence [27] still it can be lowered to a much lower level. A meta-analysis study conducted in India found that only 25% of people in rural areas and 42% of people in urban areas were aware of their hypertensive status, the study also found that only 25% rural and 38% urban Indians were being treated for hypertension [28].

Thyroid Disorder

Various kinds of thyroid disorders are prevalent in

India like Hyperthyroidism, Hypothyroidism, Goiter and Iodine deficiency, Thyroid cancer, etc. [29]. In NFHS-4 a direct question was asked on whether having any thyroid disorder or not. We found that the prevalence of thyroid disorders was high in urban areas than in rural areas. It was also found that the odds of having thyroid disorder were significantly higher among rich than poor Indians. There are only a few studies showing any association between socioeconomic status and any thyroid disorder. In a study conducted in Germany, it was found that higher-income groups were having larger thyroid volumes and increased risk of goiter [30]. On the other hand, there are other studies also which conflict with the findings of the present study, a study conducted in Meerut city of India found that low socioeconomic status was positively associated with the prevalence of goiter. We didn't find any national-level study addressing the association of socioeconomic status and thyroid disorder in India. There is a need for further comprehensive and micro-level research on thyroid disorders in India [31].

Obesity

India is gradually gaining weight. According to NFHS-4 report the percentage of overweight or obese women aged 15-49 increased from 12.6% in NFHS-3(2005-2006) to 20.7% in NFHS-4. The results of the present study clearly show the disparity in the prevalence of overweight/obesity among different-different wealth groups. From the concentration curves and values of concentration indexes, it is clearly evident that obesity is highly concentrated among the rich Indians. The odds of obesity were 13.4 times more among the richest in comparison to the poorest Indians, this shows the extent of inequality in the prevalence of obesity in India. The current findings are backed by various previous studies [[32], [33], [34]], but there were other studies also showing results opposite to the present findings [[35], [36]]. Apart from genetic factors low physical activity and flawed food habits are considered as the reason for overweight/obesity [37] [38]. In Indian context, it can be stated that these habits are more prevalent in high-income groups, as the income of a person increases it may lead to a sedentary lifestyle, a life which involves less physical activity and which can cause overweight/obesity[39]. It can be seen that the prevalence of obesity is approximately four times higher in urban areas compared to rural areas, in the future it can become a serious issue in urban areas, so a potential health policy is needed especially for urban areas, to deal with this problem.

We found that type and level of inequality in the prevalence of NCDs are different for different-different regions. In some studies, it was found that NCDs are more prevalent among poor and in some studies the findings were just opposite, the simple explanation of this could be that the coun-

tries may realize different stages of epidemiological transition at different levels of development.

We conclude that diabetes, thyroid disorders, and obesity are more concentrated among the wealthy Indians in both urban and rural areas and there is almost no inequality in the prevalence of hypertension. The distribution of NCDs by place of residence stipulates that there is a need for prevention of NCDs and risk factors of NCDs in urban and rural areas differently. There should be a policy especially for high-risk groups which must include health education about precautions and preventions for risk factors of the NCDs. Further comprehensive studies on social, economic and demographic determinants of inequality, as well as patterns of inequality in the prevalence NCDs over time, are needed for a lucid understanding of current disproportionate distributions NCDs in India. Thus, to fight against NCDs and risk factors of NCDs there is a need for a target-based approach keeping the high-risk groups in mind.

Conflict of Interest

The authors declare that they have no conflict of interest

Ethical Approval

The present study doesn't involve any human participation and Since the data is available on the public domain and open for research, so I hereby declare that no ethical concern is there in the present study.

Funding

The authors didn't receive any financial support for the research, authorship and/or publication

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