

# Epidemiological Transition in India and Determinants that Are Shifting Disease Burden: A Systematic Review

Divya A Reddy\*, Mahesh E

Department of Economics, Faculty of Humanities and Social Sciences, CHRIST (Deemed to be University), India

Received April 1, 2024; Revised June 19, 2024; Accepted July 21, 2024

## Cite This Paper in the Following Citation Styles

(a): [1] Divya A Reddy, Mahesh E, "Epidemiological Transition in India and Determinants that Are Shifting Disease Burden: A Systematic Review," *Universal Journal of Public Health*, Vol. 12, No. 4, pp. 781-791, 2024. DOI: 10.13189/ujph.2024.120418.

(b): Divya A Reddy, Mahesh E (2024). *Epidemiological Transition in India and Determinants that Are Shifting Disease Burden: A Systematic Review*. *Universal Journal of Public Health*, 12(4), 781-791. DOI: 10.13189/ujph.2024.120418.

Copyright©2024 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

**Abstract** India's disease burden patterns are shifting towards increased morbidity and mortality from Non-communicable disease and chronic diseases. This is one of the first studies conducted using the PRISMA guidelines and checklist to understand the role played by various determinants of health in this epidemiological transition happening in India. The search on 9 reputed bibliographic databases yielded 459 articles and finally 58 articles were selected based on carefully curated selection criteria. The results confirm the relation between India's demographic transition and the increasing disease burden from Non-communicable diseases (NCDs). 21 studies significantly associated urban residential status, increasing income, better living conditions and education with increasing NCDs' prevalence. 12 studies found that NCDs were more prevalent among women than men. Increased physical activity, a healthy diet and a lower hip-to-waist ratio were observed to protect against NCDs. While 9 studies found smoking tobacco and alcohol consumption were not significantly associated with the prevalence of NCDs. It is of foremost importance that India's public health policy focus must shift towards inclusivity as there is an affluent gradient to the increased morbidity and mortality from NCDs.

**Keywords** Determinants of Health, Socio-economic Determinants, Demographic Determinants, Physiological Determinants, Non-communicable Diseases, Epidemiological Transition, Public Health in India

## 1. Introduction

The epidemiological transition occurs due to changes in a country's demography, economy, society, technology and environment over time [1]. India has witnessed a remarkable transformation over the last three decades in terms of its economic growth, urbanization, demographic transition, education, infrastructure development, and advancements in industry and technology. This transformation has been reflected on its key health indicators such as mortality, morbidity, nutrition and lifestyle of Indian population. There has been a significant drop in the death rates, an increase in life expectancy, a reduction in birth rates and a commendable decrease in infant and maternal mortality [2]. Furthermore, India is witnessing a reduced disease burden from communicable and infectious diseases; and a phenomenal increase in non-communicable and chronic diseases. Such transitions are now called as epidemiological transition, based on the seminal theory "Theory of epidemiologic transition" by Abdel Omran, 1971. The three stages in his classical model are the age of pestilence and famine, the age of receding pandemics and the age of degenerative and man-made diseases.

Omran later extended his work and included the developing nations in his paper in 1998 with the 'Delayed transition model' for non-western countries [3]. According to this model for non-western countries, the three stages of epidemiological transition are: Age of pestilence and famine, the Age of receding pandemics and the "Third stage: Age of triple health burden in non-western societies". Current disease patterns in India suggest that India is in the

### Third Stage.

The leading cause of death in 1990 in India was from diarrheal diseases, while in 2019, most deaths were due to ischemic heart disease followed by chronic obstructive pulmonary disease [4]. The death rates for diabetes, chronic kidney disease and ischemic heart disease have been increasing significantly since the 1990s to surpass the deaths caused by diarrheal diseases, measles and tuberculosis. When the national figures are broken down, it can be observed that not all Indian states are experiencing epidemiological transition at the same pace. While Kerala, Punjab, Himachal, Goa and Tamil Nādu are experiencing the majority of deaths and disease burden from Non-communicable diseases (NCD). States such as Bihar, Jharkhand, Rajasthan, Uttar Pradesh and Assam are battling communicable diseases, which are the leading cause of death and disease burden in these states.

The challenges Indian healthcare system is facing in coping with this double burden are immense. India's current health expenditure was 3.54 per cent of GDP in 2018, and total public expenditure on health was 1.2 per cent in 2021, which is much lower than the world average. The proportion of out-of-pocket health expenditure is 62.6 percent of total health expenditure in 2018, which is a high burden on citizens of India and can have severe effects on morbidity and mortality among the vulnerable sections of the population [4,5,6,7]. Private healthcare providers in India dominate the market regarding curative services and inpatient care [8]. The density of the healthcare workforce is inadequate in India and highly heterogenous in the states. Rural public health infrastructure and personnel are largely insufficient concerning public health requirements [9]. Although the pace of healthcare reforms has picked up after the 1991 economics reforms with a double focus on infrastructure on one hand and healthcare technology on the other, a lot has to be done to reduce disparities in health in India [10]. There are shortages in professional human resources in healthcare, especially in the case of nursing professionals and midwives in India [11].

There is a dire need to understand the patterns and pace at which epidemiological transition is happening in various parts of the country and associate factors responsible for health inequity. The researchers, policy makers and the medical community have exhibited a lot of interest in this issue and many ground-breaking studies have taken place in the past two decades. One common factor that the majority of these studies have highlighted is the influence of socio-economic and demographic factors on morbidity and mortality. Therefore, the objective of the study is to examine the fundamental factors determining disease burden evolving through time and impacting India's epidemiological transition.

The systematic literature review in this study is split into four parts to foster clearer understanding of the role various determinants play in the epidemiological transition in India. The first part focuses only on communicable disease and infectious diseases and their reported association between

prevalence and various determinants of health. The second, third and fourth parts contain a systematic review of articles focused on Non-communicable diseases. The studies are further categorized based on socio-economic, demographic, and physiological determinants.

## 2. Systematic Review Method – PRISMA Model

A systematic review of the literature was conducted by following the reporting checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses [12]. The study is focused on published journal articles on epidemiology and epidemiological transition in India. Epidemiological transition is a concept that was made popular in the 1970s, and research on this topic was sparse before this period. This research is focused on India, and there have been no studies on epidemiological transition in India before 1970. Hence, all articles published from 1970 till 21<sup>st</sup> January 2024 were considered.

### 2.1. Selection Criteria

For this systematic review, only published journal articles, meta-analyses, systematic reviews, observational studies, comparative studies and original articles which are fully or partially focused on India or Indian states were considered. Book chapters, conference publications and news articles were excluded from the search results. Only articles representative of the entire nation were accepted to maintain uniformity. Hence, articles focused on single districts or states were not considered even though they were concentrated on epidemiological transition. Finally, the articles which addressed the factors affecting disease burden while acknowledging the epidemiological transition in India were included. The authors reviewed and shortlisted the articles from the search results only if the articles confirmed to the selection criteria.

### 2.2. Information Sources and Search Strategy

The last search was conducted on 21<sup>st</sup> January, 2024, on Wiley online library, Emerald, JSTOR, ProQuest Central, Science Direct, Springer Open and Google Scholar. Keywords “Epidemiological transition”, “India”, “Shifting disease burden” and “Disease burden” were used to screen the relevant titles and abstracts. For Google scholar, however, the strategy was slightly different as we could search for keywords in either titles or entire articles. Therefore, we used Boolean logic “OR” for the search. The keywords were screened on the databases in various combinations to yield optimum results.

### 2.3. Selection Bais

By only including published journal articles, meta-analyses, systematic reviews, observational studies, comparative studies, and original articles, the review may

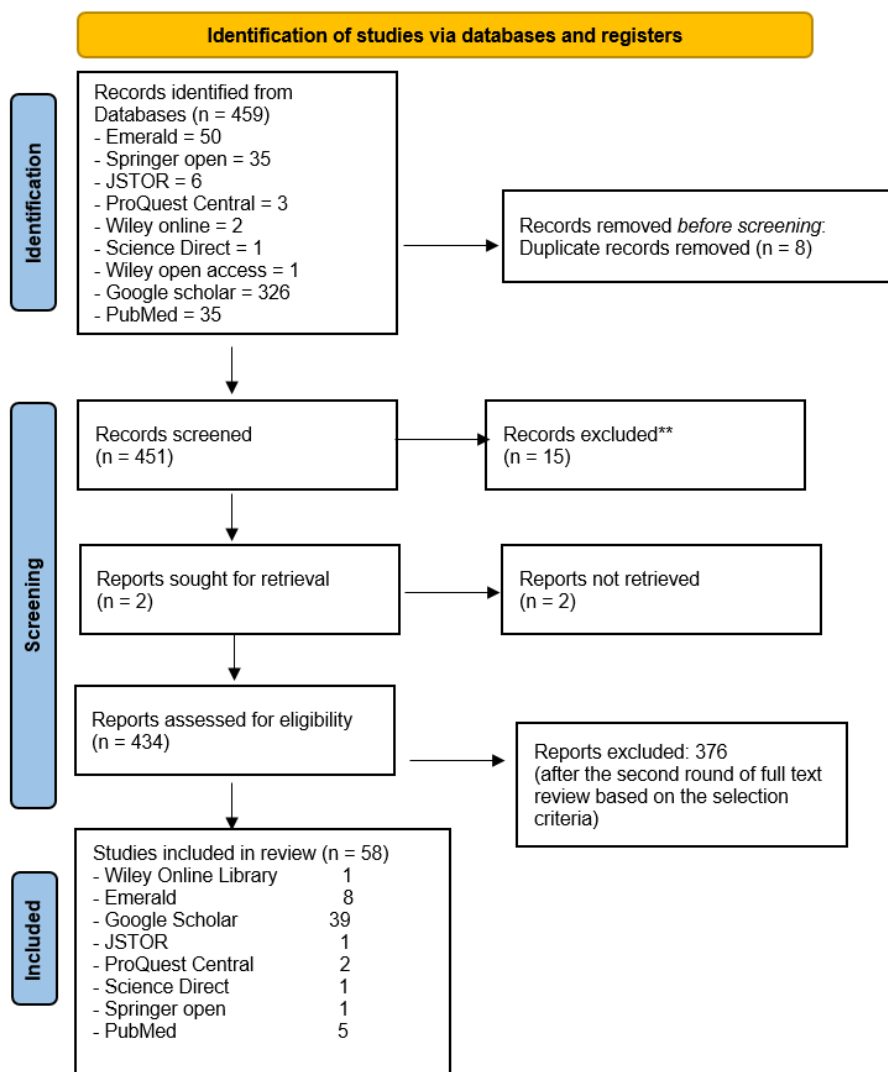
inadvertently exclude relevant data from unpublished sources such as gray literature, conference proceedings, or government reports. This could result in an incomplete representation of the epidemiological landscape in India, as studies with negative or null results are less likely to be published. Restricting the inclusion criteria to articles representative of the entire nation and excluding studies focused on single districts or states may lead to a bias towards urban or more economically developed regions, neglecting the unique epidemiological profiles of rural or less developed areas. This could result in an incomplete understanding of the epidemiological transition across different geographical regions in India. Limiting the search to articles published from 1970 onwards may overlook

valuable historical data on the epidemiological transition in India before this period. This could potentially skew the analysis and interpretation of long-term trends and patterns in disease burden and epidemiological transition.

**2.4. Selection Process**

The articles identified by the databases were entered in MS excel spreadsheet for proper classification. The authors independently assessed the titles and abstracts based on the selection criteria. All the screening was done manually and no automation tools were used. The full texts of the articles were assessed based on the criteria. The following are the outcomes.

**2.5. Outcomes**



Source: Authors compilation based on the search results and selection criteria.

\*\* 15 results namely 7 book chapters, 3 conference publications, 1 commentary, 1 seminar report, 2 thesis and 1 working paper were excluded.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: <http://www.prisma-statement.org/>

**Figure 1.** Flow Diagram of systematic literature search on epidemiological transition in India and determinants that are shifting disease burden

### 3. Results of Synthesis

Table 1 displays the list of all articles included in this systematic review. This table is divided according the structure of this review article. The first section discusses the important findings from the review of articles focused on disease burden from communicable diseases and its determinants in India. The second section is focused on non-communicable diseases and its determinants which are further divided into socioeconomics determinants, demographic determinants, physiological and lifestyle determinants of prevalence of NCDs.

**Table 1.** The list of studies included in the review categorised according to the determinants of health

| COMMUNICABLE DISEASES  |  |
|--|--|
| Determinants of Health   | Relevant studies included in the review  |
| Education, ethnicity, Age, Socio Economics Status, Sanitation practices and access to clean drinking water | Mathur, P., & Arora, N. K. (2008);<br>Gopal Agrawal (2015); Banerjee, A., & Dwivedi, S. (2016); Dandona, R., et al. (2017); Dhiman, A., et al. (2018); Ghildayal, N. S. (2019); Ram, S., & Thakur, V. (2021) and Mala Ray (2021).  |
| NON COMMUNICABLE DISEASE   |  |
| Determinants of Health   | Relevant studies included in the review  |
| <b>Socioeconomic Determinants</b>  | Arokiasamy and Uttamacharya (2013); Jeemon and Ks Reddy (2010); Prakash and Wejnert (2015); Gopal Agrawal (2015); Mistry and Puthuserry (2015); Gaur and Ram (2016); Prabhakaran et al. (2016); Adaji et al. (2016); Banerjee and Dwivedi (2016); Kindo et al. (2016); Seth and Mohanthy (2017); Tabutin et al. (2017); Self S and Basuroy (2017); Agrawal and Patel (2017); Paul and Singh (2017); Singh and Dixit (2017); Arokiasamy et al. (2015); Bhise et al. (2018); Luhar S, et al. (2018); Yadav et al. (2018); Kulkarni et al. (2019); Singh et al. (2020); Isrhad and Dash (2021); Puri et al. (2021); Mondal (2021); Srivatsava et al. (2021); Chauhan et al. (2021); Muhammed et al. (2021) ; Khan Mr et al. (2022); Jana and Chattopadyaya (2022) and Dolui M et al. (2023)   |
| <b>Demographic Determinants</b>  | S. Khandelwal and K. S. Reddy (2013); Arokiasamy and Uttamacharya (2013); Dubey and Mohanty (2014); S Yadav and Arokiasamy (2014); Arokiasamy and Yadav (2014); Gopal Agrawal (2015); Arokiasamy et al. (2015); Gaur and Ram (2016); Banerjee and Dwivedi (2016); Kindo et al. (2016); Adaji et al. (2016); Dandona, et al. (2017); Self S and Basuroy (2017); Abhishek Singh et al. (2017); Agrawal and Patel (2017); Paul and Singh (2017); Singh and Dixit (2017); Bhise et al. (2018); Luhar S, et al. (2018); Yadav et al. (2018); Singh and Srivatsava (2018); Kulkarni et al. (2019); Singh et al. (2020); Yadav and Singh (2020); Tabutin et al. (2017).<br><br>Irshad (2021); Isrhad and Dash (2021); Puri et al. (2021); Srivatsava et al. (2021); Chauhan et al. (2021); Mondal (2021); myhammed et al. (2021); Chauhan et al. (2021); Singh Gupta et al. (2020); Yadav (2021); Chandola et al. (2018); Khan Mr et al. (2022); Jana and Chattopadyaya (2022); S. Yadav et al. (2022) and Dolui M et al. (2023). |
| <b>Physiological and Lifestyle determinants</b>  | S. Khandelwal and K. S. Reddy (2013); Arokiasamy and Uttamacharya (2013); Gopal Agrawal (2015); Prabhakaran et al. (2016); Arokiasamy et al. (2015); Adaji et al. (2016); Kindo et al. (2016); Singh and dixit (2017); Arokiasamy et al. (2015); Singh and Srivatsava (2018); Gupta and Xavier (2018); Kulkarni et al. (2019); Hills (2018); Misra et al. (2014); Dandona, et al. (2017); Irshad (2021); Isrhad and Dash (2021); gupta and bansal (2020); Srivatsava et al. (2021); Singh et al. (2020); myhammed et al. (2021); Chauhan et al. (2021).<br><br>Mondal (2021); Mistry and Puthuserry (2015); A Misra et al. (2018); Kumar M et al. (2023) and Puri et al. (2021).   |

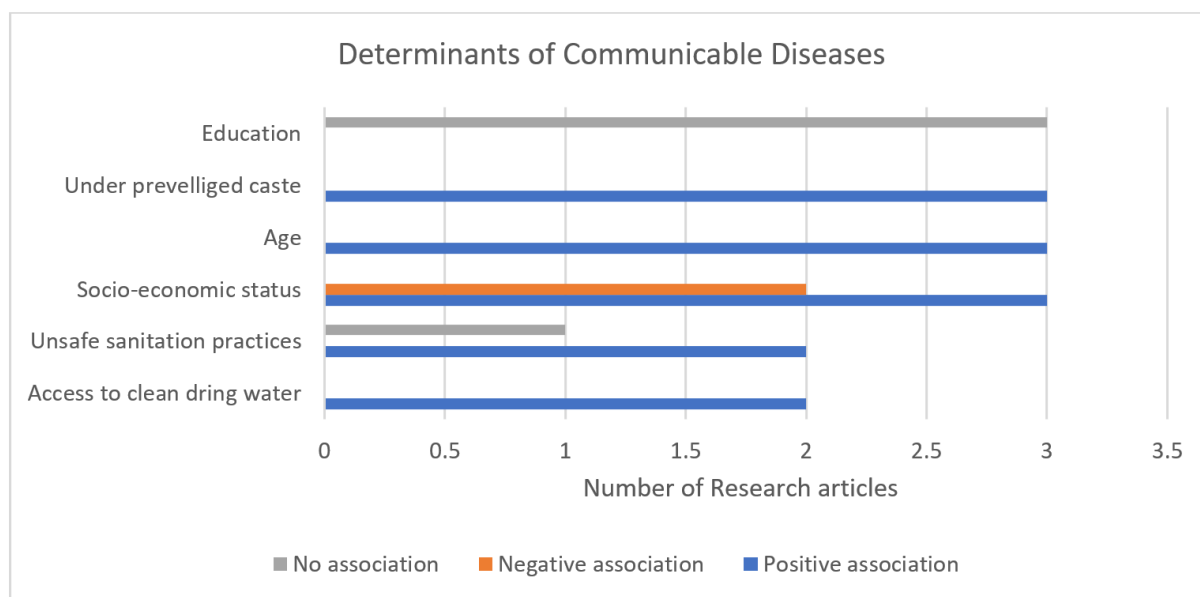
Source: Authors compilation

#### 3.1. Communicable Diseases

Although the disease burden from communicable and infectious diseases is no longer the highest contributor, the absolute figures with respect to mortality and morbidity from these diseases are still very high in many regions of India. Especially in the states where the epidemiological transition is still low, they are facing heavy burden from both communicable diseases and NCDs.

The above studies extensively studied the determinants associated with prevalence of infectious and communicable diseases in India [4, 13-17]. From the

synthesized results, age is noted to be a significantly associated factor in three articles (see figure 2) as most of the disease burden in this category is concentrated in the younger age groups [13,14,16]. Most studies have considerably associated the prevalence of communicable and infectious diseases with standard of living factors (see figure 2). The results are mixed as some studies attribute a higher standard of living as a protective factor against communicable and infectious diseases, while others attribute it to increasing prevalence. Disease-wise split could provide a better explanation for this result [13-15].



Source: Authors compilation of results from systematic review on Communicable diseases and determinants of health.

**Figure 2.** Summary of characteristics of studies used in this systematic review and their reported association between the prevalence of communicable and infectious diseases and various determinants of health

Three studies did not find any association between education and the prevalence of communicable and infectious diseases [14,15,18]. People belonging to underprivileged castes and people residing in rural are more prone to this category of diseases. Safe drinking water, improved sanitation and handwashing practices are significantly associated with providing a protective effect against communicable and infectious diseases. Socio-economic factors such as indoor piped drinking water, separate kitchen in the household, electricity in the houses and a lack of regular intake of meals are important predictors of ill health, as it was shown that these factors have shown to reduce the number of medical treatments by migrants who mostly reported to suffer from communicable diseases [13].

### 3.2. Non Communicable and Chronic Diseases

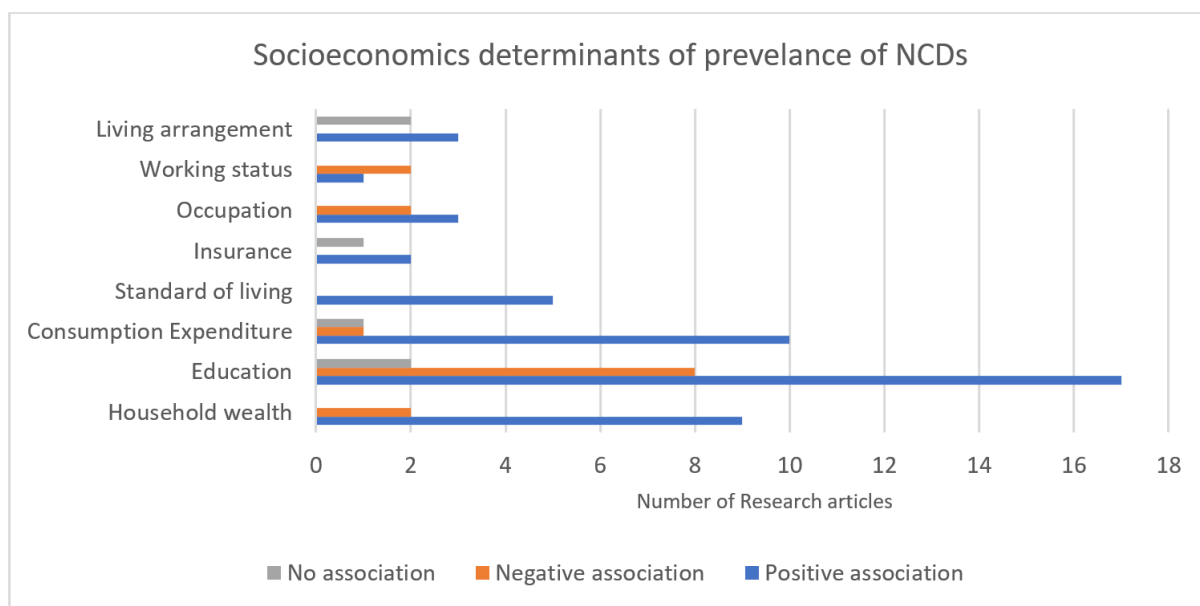
In the past three decades, there has been an evident change in the disease patterns. The leading cause of morbidity and mortality in India today is caused by Non-communicable diseases, with cardiovascular ailments and diabetes being the leading factors [4]. In this period, India has experienced demographic transition, which has also been reflected in its epidemiological transition patterns. There is a need to understand the factors propelling this transition and to tailor the country’s public health policies to cater to the double burden the population is faced with respect to both the increasing burden from communicable diseases and the substantial burden from infectious and communicable diseases. The studies reviewed in this systematic review have been categorized based on the determinants they have associated with Non-communicable diseases into three heads, namely,

socio-economic factors, demographic factors and physiological factors.

#### 3.2.1. Socio-economic Factors

Socioeconomic factors such as standard of living, household wealth, per capita expenditure, education, insurance, source of water, sanitation, household size, living arrangements, occupation and employment status are the important determinants of prevalence of non-communicable diseases that are examined in above listed studies (see figure 3).

Education as a determinant of NCDs prevalence has produced diverse results in the above listed studies, with many studies showing that NCDs prevalence is higher among population with higher levels of education [15, 19-34]. While a good number of studies have not been able to significantly associate level of education with prevalence of NCDs [14, 35-42]. However, most studies on Non-communicable diseases considered in this study report that an improvement in socio-economic factors is positively associated with greater prevalence of NCDs and chronic illnesses (see figure 3). The affluent gradient to prevalence of NCDs and multimorbidity cannot be overlooked. Covariates related to affluence in socioeconomic status such as higher income, caste, place of residence and access to clean drinking water and sanitation have been linked to higher prevalence of NCDs [38,43]. Educated older adults were 1.4 times more likely to report morbidity compared to illiterate older adults [15]. Educated individuals from urban areas were more likely to be diagnosed with hypertension and diabetes when compared to their rural counterparts with similar characteristics.



Source: Authors compilation of results from systematic review on Non-communicable diseases and socioeconomic determinants of health.

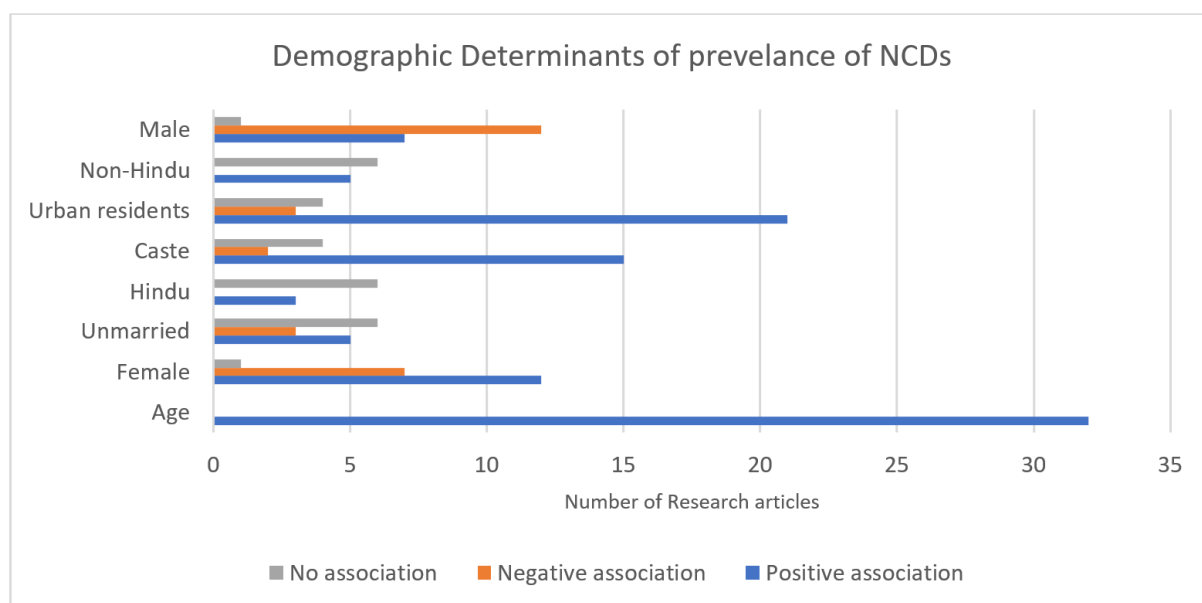
**Figure 3.** Summary of characteristics of studies used in this systematic review and their reported association between the prevalence of Non-communicable diseases (NCDs) and Socio-economic determinants of health

The majority of the research included in this study has found a positive association between wealth and prevalence of Non-communicable diseases and chronic diseases. Individuals from lower income groups and underprivileged castes were more likely to die from communicable diseases and injuries while individuals from high income group and privileged castes were likely to die from noncommunicable diseases [14,44]. The elderly population in India belonging to poorer household was more likely to suffer from short-term morbidity and elders from richer households were more likely to suffer from long-term morbidity [35].

There is an 11-year difference in life expectancy at birth between the poor and non-poor in India. The risk of having NCDs increased in the Scheduled Castes/Tribes, the never-married, households paying no medical insurance, and households with low monthly expenditures [15]. Unemployed youth and youth seeking jobs are more likely to be affected by depressive symptoms and other mental health problems [21].

### 3.2.2. Demographic Factors

Interrelation between demographic and epidemiological transitions has been evident in recent decades as mortality patterns are shifting with transitioning age structures in a population influencing the disease patterns [14]. All the studies included in this review have found a positive association between age and the prevalence of NCDs (see figure 4) [2,14-16,19-21,23,24,25,27,28,30-36,39,40,44-57]. According to the NSS data, NCDs and chronic illnesses' prevalence rates have doubled every decade since 1986. The ageing population in India is a major driver of the epidemiological shift in public health. Rising premature deaths from non-communicable diseases can be linked to demographic transition in the population. As a population is experiencing demographic and epidemiological transition, there can be an increased health burden on the systems of older adults suffering from non-communicable diseases and chronic diseases. India has to gear up to this challenge and protect its elderly and facilitate a healthy ageing experience for its ageing population [36].



Source: Authors compilation of results from a systematic review on Non-communicable diseases and demographic determinants of health.

**Figure 4.** Summary of characteristics of studies used in this systematic review and their reported association between prevalence of non-communicable diseases (NCDs) and Demographic determinants of health

The results are mixed when an association between gender and NCDs is viewed. Sixteen studies reported a greater prevalence of NCDs among women, while seven reported a greater prevalence among men. The life expectancy (LE) of the Indian population has increased by more than 10 years in the last three decades, with female LE more than male LE [35]. Women in general and in India have greater life expectancy than men. Still, an increasing number of studies are noting the inequality in prevalence with respect to Non-communicable diseases for women. Women in India seem to be in a disadvantageous position not only in matters of education, labour force participation, wealth and political participation but also in matters of health conditions [26,27].

Twenty-one studies have reported a significant association between place of residence and prevalence or disease burden of NCDs, while 7 studies have reported no association. These 21 studies point out that urban residents are more likely to suffer from morbidity and mortality from NCDs when compared to their rural counterparts. The gap between the urban areas and rural areas concerning NCDs is only widening as the epidemiological transition is taking place at a quicker pace in the urban population as compared to the rural population [2].

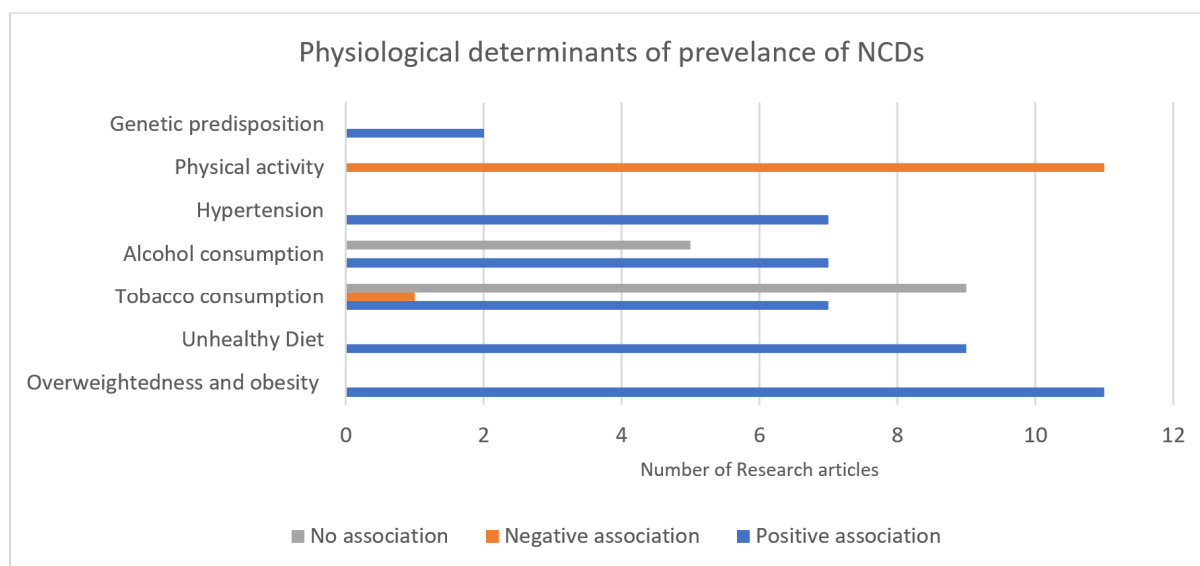
Ten studies reported a significant association between marital status and prevalence or disease burden of NCDs, while six found no significant association. The prevalence rate of chronic disease was relatively lower among married elders and those living with children [30]. Most of the studies in this review found that unmarried individuals, especially older ones, were more likely to suffer from morbidity and mortality from NCDs.

Mixed results can be observed when religion and caste are focused upon. Eight studies have found a significant association between religion and disease burden of NCDs, while seven studies have reported no significant association. Among the studies that reported significant association, the majority point out that the prevalence of NCDs was greater among the Hindu population. 13 studies reported a positive association between caste and disease burden and/or NCDs (see figure 4). In comparison, only three studies reported no association. Most of the studies in this review report higher disease burden of NCDs among the privileged castes compared to underprivileged castes (Scheduled castes and tribes), again highlighting the NCDs as a disease associated with affluence in India.

### 3.2.3. Lifestyle and Physiological Factors

Among the lifestyle and physiological factors, all the studies in this review have identified that overweightness, body mass index, waist-to-hip ratio and hypertension are positively associated with the prevalence of NCDs [14,16,22,28,30,32-36,40,43,45,57-67]. O-O (overweight and obesity) are the most significant risk indicators for non-communicable diseases (see figure 5). India is experiencing nutrition transition along with the epidemiological transition, where there is a reversal of the trend with overweight prevalence exceeding undernutrition prevalence. This can be observed by reducing the gap between undernutrition and overnutrition. Undernutrition exceeded overnutrition by 23.6% a decade ago, and today the gap between the two is just 2 % with O-O prevalence at 26% and underweight prevalence at 22.5 % [58].





Source: Authors compilation of results from systematic review on Non communicable diseases and Physiological determinants of health.

**Figure 5.** Summary of characteristics of studies used in this systematic review and their reported association with prevalence of Non-communicable diseases (NCDs) and lifestyle and physiological determinants of health

All the studies in this review have associated physical activity and a healthy diet with a higher fruit and vegetable intake ratio with a protective effect against NCDs prevalence (see figure 5). This highlights the importance of promoting physical activity and a healthy diet in our public health policy. Diverse lifestyle patterns in India are a result of economic and cultural heterogeneity, which can be considered essential propellers of epidemiological transition along with the demographic transition that is taking place in India [31].

Contrary to common perception, most studies in this review have not been able to establish a significant relationship between smoking tobacco and alcohol consumption with the prevalence of NCDs. Further investigation needs to be made in this area as these behavioural risk factors are becoming increasingly popular among the young population in the country [25].

## 4. Conclusions

India is undergoing a demographic change, which has resulted in an epidemiological shift in disease patterns during the last few decades. Abdel Omran's Third Stage of Epidemiological Transition for Non-Western Countries is an ideal fit for India. Although life expectancy is steadily increasing in India as morbidity and mortality from communicable and infectious diseases are falling, the absolute figures for morbidity and mortality from these diseases are still large. Furthermore, India is facing an increasing disease burden from man-made degenerative and lifestyle diseases like cardiovascular diseases, diabetes, respiratory disorders and other chronic illnesses. Healthcare in India has expanded and progressed significantly. However, it remains inaccessible and

unaffordable for vulnerable sections of the population. This situation amounts to a triple burden on public health. Hence, a customized and targeted health policy is required to tackle this challenge. Indian health policy should become more inclusive as there is an affluent gradient in the prevalence of non-communicable and chronic diseases. The prevalence rates are higher among the relatively wealthier, more educated, urbanized and older population.

Furthermore, lifestyle factors like reduced physical activity, poor diet, being overweightness and obesity are highly significant factors affecting this epidemiological shift of disease burden from communicable and infectious diseases to non-communicable and chronic diseases. This shift is skewed with the disease burden concentrated among older age groups. Therefore, a special focus on the elderly population is needed as it has to match the pace of the demographic transition and epidemiological transition that is taking place along with increasing rate of Urbanisation.

The findings of the different themes of this systematic research have thrown light on important studies focused on epidemiological transition in India and the different aspects of the determinants of health and their impact on shifting of disease burden. Many studies included in this review have observed the determinants and relation to shifting disease burden in countries, but very few studies examine the interstate differences and patterns in epidemiological transition with respect to social, demographic and physiological determinants of health. There is a need for further research to explore other potential risk factors, such as role of stress, sleep patterns, pollution exposure and occupational hazards towards NCDs in India. The time is ripe for a multipronged approach to target NCDs as the prevalence rate is creeping up in younger age groups in some regions. Policies should target to create more



awareness about nutrition and physical activity as most studies included in this study have concluded that healthy diet and moderate physical activity are essential for preventing NCDs. Prevalence of smoking tobacco and alcoholism among younger population is crucial to prevent further rise in NCDs. Policymakers and the government should work together to create spaces that promote physical activity in congested urban areas. There is a need for further research to examine why some states are experiencing epidemiological transition faster than others and how Indian states are differing in epidemiological transition compared to other non-western developing countries. In light of this, the future directions can be the culmination of primary data and secondary data analysis to provide reliable evidence to policymakers for future health policies in the non-western developing countries where the rate of urbanisation is rapidly increasing and the demographic profile of the nation is mostly young with a rising older population due to an increase in life expectancy.

## REFERENCES

- [1] Omran, A. R. (1971). The epidemiologic transition: a theory of the epidemiology of population change. *The Milbank Memorial Fund Quarterly*, 49, 509-538. <https://link.gale.com/apps/doc/A72265668/AONE?u=anon~5fef3681&sid=googleScholar&xid=ddb4e713>
- [2] Arokiasamy, P., & Yadav, S. (2014). Changing age patterns of morbidity vis-à-vis mortality in India. *Journal of biosocial science*, 46(4), 462-479. <https://doi.org/10.1017/S002193201300062X>
- [3] Omran, A. R. (1998). The epidemiologic transition theory revisited thirty years later. *World health statistics quarterly*, 53(2, 3, 4), 99-119. <https://iris.who.int/bitstream/handle/10665/330604/WHSQ-1998-51-n2-3-4-eng.pdf>
- [4] Dandona, L., Dandona, R., Kumar, G. A., Shukla, D. K., Paul, V. K., Balakrishnan, K., ... & Thakur, J. S. (2017). Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. *The Lancet*, 390(10111), 2437-2460. [https://doi.org/10.1016/S0140-6736\(17\)32804-0](https://doi.org/10.1016/S0140-6736(17)32804-0)
- [5] National health Policy, 2017, Ministry of health and family welfare, government of India, [https://www.nhp.gov.in/nhp\\_files/national\\_health\\_policy\\_2017.pdf](https://www.nhp.gov.in/nhp_files/national_health_policy_2017.pdf)
- [6] World Inequality report 2022, <https://wid.world/news-article/world-inequality-report-2022/>
- [7] World Health Organization Global Health Expenditure database [apps.who.int/nha/database](https://apps.who.int/nha/database)
- [8] Balarajan, Y., Selvaraj, S., & Subramanian, S. V. (2011). Health care and equity in India. *The Lancet*, 377(9764), 505-515. [https://doi.org/10.1016/S0140-6736\(10\)61894-6](https://doi.org/10.1016/S0140-6736(10)61894-6)
- [9] Kasthuri, A. (2018). Challenges to healthcare in India-The five A's. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine*, 43(3), 141. [https://doi.org/10.4103/ijcm.IJCM\\_194\\_18](https://doi.org/10.4103/ijcm.IJCM_194_18)
- [10] Wani, N. U. H., Taneja, K., & Adlakha, N. (2013). Health system in India: Opportunities and challenges for enhancements. *IOSR Journal of Business and Management (IOSR-JBM)*, 9(2), 74-82. e-ISSN: 2278-487X, p-ISSN: 2319-7668.
- [11] Prakash, N., & Wejnert, B. (2011). Health, Development, and Democracy: Health Systems in Southeast Asia and in Eastern Europe. In *Democracies: Challenges to Societal Health (Research in Political Sociology, Vol. 19)*. Emerald Group Publishing Limited, Leeds, pp. 43-56. [https://doi.org/10.1108/S0895-9935\(2011\)0000019007](https://doi.org/10.1108/S0895-9935(2011)0000019007)
- [12] Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., ... & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of clinical epidemiology*, 62(10), e1-e34. <https://doi.org/10.7326/0003-4819-151-4-200908180-00136>
- [13] Mathur, P., & Arora, N. K. (2008). Epidemiological transition of hepatitis A in India: issues for vaccination in developing countries. *Indian Journal of Medical Research*, 128(6). [https://journals.lww.com/ijmr/abstract/2008/28060/epidemiological\\_transition\\_of\\_hepatitis\\_a\\_in.7.aspx](https://journals.lww.com/ijmr/abstract/2008/28060/epidemiological_transition_of_hepatitis_a_in.7.aspx)
- [14] Agrawal, G. (2015). Health transition in India: does data on causes of death reveal trends, patterns and determinants?. *International Journal of Human Rights in Healthcare*, 8(2), 92-109. <https://doi.org/10.1108/IJHRH-11-2014-0030>
- [15] Banerjee, K., & Dwivedi, L. K. (2016). The burden of infectious and cardiovascular diseases in India from 2004 to 2014. *Epidemiology and health*, 38. <https://doi.org/10.4178/epih.e2016057>
- [16] Ghildayal, N. (2020). Epidemiological shift of hepatitis A in EAGLE countries—a projection. *International Journal of Health Care Quality Assurance*, 33(1), 110-119. DOI: 10.1108/IJHCQA-05-2019-0097
- [17] Ram, B., & Thakur, R. (2022). Epidemiology and economic burden of continuing challenge of infectious diseases in India: Analysis of socio-demographic differentials. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.901276>
- [18] Bhattacharjee, M. R. (2021). Mobility and morbidity of regular and seasonal migrants in India. *International Journal of Migration, Health and Social Care*, 17(2), 155-165. <https://doi.org/10.1108/IJMHS-04-2020-0038>
- [19] Self, S., & Basuroy, S. (2017). Factors influencing healthcare choices by the elderly in India: Role of social interactions. *International Journal of Social Economics*, 44(9), 1231-1251. <https://doi.org/10.1108/IJSE-12-2015-0340>
- [20] Agrawal, G., & Patel, S. K. (2017). Religious differentials in morbidity prevalence and health care seeking behaviours among older persons in India. *International Journal of Human Rights in Healthcare*, 10(1), 14-27. <https://doi.org/10.1108/IJHRH-09-2016-0015>
- [21] Gaur, K., & Ram, U. (2016). Mental health problems among youth in India and its correlates. *International*

- Journal of Human Rights in Healthcare, 9(2), 95-108. <https://doi.org/10.1108/IJHRH-08-2015-0024>
- [22] Prabhakaran, D., Jeemon, P., & Roy, A. (2016). Cardiovascular diseases in India: current epidemiology and future directions. *Circulation*, 133(16), 1605-1620. <https://doi.org/10.1161/CIRCULATIONAHA.114.008729>
- [23] Paul, K., & Singh, J. (2017). Emerging trends and patterns of self-reported morbidity in India: Evidence from three rounds of national sample survey. *Journal of Health, Population and Nutrition*, 36(1), 1-13. <https://doi.org/10.1186/s41043-017-0109-x>
- [24] Singh, S., Puri, P., & Subramanian, S. V. (2020). Identifying spatial variation in the burden of diabetes among women across 640 districts in India: a cross-sectional study. *Journal of Diabetes & Metabolic Disorders*, 19(1), 523-533. <https://doi.org/10.1007/s40200-020-00545-w>
- [25] Srivastava, S., KJ, V. J., Drishti, D., & Muhammad, T. (2021). Interaction of physical activity on the association of obesity-related measures with multimorbidity among older adults: a population-based cross-sectional study in India. *BMJ open*, 11(5), e050245. <https://doi.org/10.1136/bmjopen-2021-050245>
- [26] Bhise, M. D., Patra, S., & Chaudhary, M. (2018). Geographical variation in prevalence of non-communicable diseases (NCDs) and its correlates in India: evidence from recent NSSO survey. *Journal of Public Health*, 26(5), 559-567. <https://doi.org/10.1007/s10389-017-0889-x>
- [27] Puri, P., Singh, S. K., & Pati, S. (2021). Temporal dynamics, patterns and correlates of single and multimorbidity in India, 1994–2018. *Journal of Multimorbidity and Comorbidity*, 11, 26335565211062756. <https://doi.org/10.1177/26335565211062756>
- [28] Adaji, E. E., Ahankari, A. S., & Myles, P. R. (2017). An investigation to identify potential risk factors associated with common chronic diseases among the older population in India. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine*, 42(1), 46. <https://doi.org/10.4103/0970-0218.199802>
- [29] Luhar, S., Mallinson, P. A. C., Clarke, L., & Kinra, S. (2018). Trends in the socioeconomic patterning of overweight/obesity in India: a repeated cross-sectional study using nationally representative data. *BMJ open*, 8(10), e023935. <https://doi.org/10.1136/bmjopen-2018-023935>
- [30] Arokiasamy, P., & Uttamacharya, U. (2013). Multiple chronic diseases and co-morbidities among older adults in India: New insights from Lasi Pilot, 2010. Available at SSRN 2307650. <https://doi.org/10.2139/ssrn.2307650>
- [31] Singh, S. K., Gupta, J., Sharma, H., Pedgaonkar, S. P., & Gupta, N. (2020). Socio-economic correlates and spatial heterogeneity in the prevalence of asthma among young women in India. *BMC Pulmonary Medicine*, 20(1), 1-12. <https://doi.org/10.1186/s12890-020-1124-z>
- [32] Kindo, B. K., Himanshu, R., Parmar, K., Dube, S., & Ramesh, J. (2016). Socioeconomic and demographic trends in the prevalence of type 2 diabetes in India. *Journal of Social Health and Diabetes*, 4(02), 090-101. <https://doi.org/10.4103/2321-0656.188001>
- [33] Muhammad, T., Maurya, P., & Sharma, P. (2021). Prevalence and correlates of bone and joint diseases and its association with falls among older adults in India: evidence from LASI, 2017–18. *Geriatric nursing*, 42(5), 1143-1150. <https://doi.org/10.1016/j.gerinurse.2021.07.007>
- [34] Singh, A., & Dixit, S. (2017). Socioeconomic Patterning of Cardiovascular Disease and its Risk Factors among Indians: A Systematic Review of Literature. *International Journal of Medicine and Public Health*, 7(1). <https://doi.org/10.5530/ijmedph.2017.1.1>
- [35] Irshad, C. V., & Dash, U. (2021). Healthy aging in India: evidence from a panel study. *Journal of Health Research*, (ahead-of-print). <https://doi.org/10.1108/JHR-09-2020-0395>
- [36] Irshad, C. V., Dash, U., & Muraleedharan, V. R. (2022). Healthy ageing in india; a quantile regression approach. *Journal of Population Ageing*, 15(1), 217-238. <https://doi.org/10.1007/s12062-021-09340-8>
- [37] Arokiasamy, P., Uttamacharya, U., Jain, K., Biritwum, R. B., Yawson, A. E., Wu, F., ... & Kowal, P. (2015). The impact of multimorbidity on adult physical and mental health in low-and middle-income countries: what does the study on global ageing and adult health (SAGE) reveal?. *BMC medicine*, 13(1), 1-16. <https://doi.org/10.1186/s12916-015-0402-8>
- [38] Yadav, P., Kulkarni, V. S., & Gaiha, R. (2018). Growing burden of non-communicable diseases in India. [https://repository.upenn.edu/psc\\_publications/20](https://repository.upenn.edu/psc_publications/20)
- [39] Kulkarni, V. S., Kulkarni, V. S., & Gaiha, R. (2019). Persistence of non-communicable diseases, affluence and inequality in India. [https://repository.upenn.edu/psc\\_publications/30](https://repository.upenn.edu/psc_publications/30).
- [40] Mondal, B. (2021). Impact of state of economic dependence and employment status on the self-perceived health of Indian elderly people across expenditure quintiles of households. *Ageing & Society*, 1-23. <https://doi.org/10.1017/S0144686X21000908>
- [41] Seth, N., & Mohanty, S. K. (2017). Poor and non-poor differentials in household health spending in India. *Journal of Public Health*, 25, 75-86. <https://doi.org/10.1007/s10389-016-0765-0>
- [42] Jeemon, P., & Reddy, K. S. (2010). Social determinants of cardiovascular disease outcomes in Indians. *The Indian journal of medical research*, 132(5), 617. <https://doi.org/10.4103/0971-5916.73415>
- [43] Mistry, S. K., & Puthussery, S. (2015). Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence. *Public health*, 129(3), 200-209. <https://doi.org/10.1016/j.puhe.2014.12.004>
- [44] Tabutin, D., Masquelier, B., Grieve, M., & Reeve, P. (2017). Mortality inequalities and trends in low-and middle-income countries, 1990-2015. *People*, 72(2), 221-296. <https://www.jstor.org/stable/26383328>
- [45] Chauhan, S., Gupte, S. S., Kumar, S., & Patel, R. (2021). Urban-rural differential in diabetes and hypertension among elderly in India: A study of prevalence, factors, and treatment-seeking. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 15(4), 102201.

<https://doi.org/10.1016/j.dsx.2021.102201>

- [46] Dubey, M., & Mohanty, S. K. (2014). Age and sex patterns of premature mortality in India. *BMJ open*, 4(8), e005386. <https://doi.org/10.1136/bmjopen-2014-005386>
- [47] Yadav, S., & Arokiasamy, P. (2014). Understanding epidemiological transition in India. *Global health action*, 7(1), 23248. <https://doi.org/10.3402/gha.v7.23248>
- [48] Singh, A., Shukla, A., Ram, F., & Kumar, K. (2017). Trends in inequality in length of life in India: a decomposition analysis by age and causes of death. *Genus*, 73(1), 1-16. <https://doi.org/10.1186/s41118-017-0022-6>
- [49] Yadav, A. K., & Singh, A. (2020). Age-and sex-specific burden of morbidity and disability in India: A current scenario. *Evaluation of Health Services*, 1, 11-13. <https://doi.org/10.5772/intechopen.89709>
- [50] Chauhan, S., Kumar, S., Patel, R., Simon, D. J., & Kumari, A. (2022). Burden of communicable and non-communicable diseases-related inequalities among older adults in India: a study based on LASI survey. *BMC geriatrics*, 22(1), 1-12. <https://doi.org/10.1016/j.dsx.2021.102201>
- [51] Yadav, S. (2021). Progress of inequality in age at death in India: role of adult mortality. *European Journal of Population*, 37(3), 523-550. <https://doi.org/10.1007/s10680-021-09577-1>
- [52] Chandola, T., Mikkilineni, S., Chandran, A., Bandyopadhyay, S. K., Zhang, N., & Bassanesi, S. L. (2018). Is socioeconomic segregation of the poor associated with higher premature mortality under the age of 60? A cross-sectional analysis of survey data in major Indian cities. *BMJ open*, 8(2), e018885. <https://doi.org/10.1136/bmjopen-2017-018885>
- [53] Khan, M. R., Malik, M. A., Akhtar, S. N., Yadav, S., & Patel, R. (2022). Multimorbidity and its associated risk factors among older adults in India. *BMC Public Health*, 22(1), 746. <https://doi.org/10.1186/s12889-022-13181-1>
- [54] Jana, A., & Chattopadhyay, A. (2022). Prevalence and potential determinants of chronic disease among elderly in India: rural-urban perspectives. *Plos one*, 17(3), e0264937. <https://doi.org/10.1371/journal.pone.0264937>
- [55] Yadav, S., Perianayagam, A., Patel, S. A., & Cunningham, S. A. (2022). The role of age inequalities in cause of death in the slow pace of epidemiological transition in India. *Scientific Reports*, 12(1), 20291. <https://doi.org/10.1038/s41598-022-23599-7>
- [56] Dolui, M., Sarkar, S., Hossain, M., & Manna, H. (2023). Demographic and socioeconomic correlates of multimorbidity due to Non-communicable diseases among adult men in India: Evidence from the nationally representative survey (NFHS-5). *Clinical Epidemiology and Global Health*, 23, 101376. <https://doi.org/10.1016/j.cegh.2023.101376>
- [57] Khandelwal, S., & Reddy, K. S. (2013). Eliciting a policy response for the rising epidemic of overweight-obesity in India. *Obesity reviews*, 14, 114-125. <https://doi.org/10.1111/obr.12097>
- [58] Gupta, S., & Bansal, S. (2020). Nutritional Transition and Associated Epidemiological Transition in India. Available at SSRN 3436893. <https://doi.org/10.2139/ssrn.3436893>
- [59] Dhiman, R. C., & Tiwari, A. (2018). Emergence of zoonotic diseases in India: A systematic review. *Med Rep Case Stud*, 3(3), 163. <https://doi.org/10.4172/2572-5130.1000163>
- [60] Gupta, R., & Xavier, D. (2018). Hypertension: the most important non communicable disease risk factor in India. *Indian heart journal*, 70(4), 565-572. <https://doi.org/10.1016/j.ihj.2018.02.003>
- [61] Hills, A. P., Arena, R., Khunti, K., Yajnik, C. S., Jayawardena, R., Henry, C. J., ... & Misra, A. (2018). Epidemiology and determinants of type 2 diabetes in south Asia. *The lancet Diabetes & endocrinology*, 6(12), 966-978. [https://doi.org/10.1016/S2213-8587\(18\)30204-3](https://doi.org/10.1016/S2213-8587(18)30204-3)
- [62] Kumar, M., Kumari, N., Chanda, S., & Dwivedi, L. K. (2023). Multimorbidity combinations and their association with functional disabilities among Indian older adults: evidence from Longitudinal Ageing Study in India (LASI). *BMJ open*, 13(2), e062554. <https://doi.org/10.1136/bmjopen-2022-062554>
- [63] Misra, A., Ramchandran, A., Jayawardena, R., Shrivastava, U., & Snehalatha, C. (2014). Diabetes in south Asians. *Diabetic Medicine*, 31(10), 1153-1162. <https://doi.org/10.1111/dme.12540>
- [64] Misra, A., Soares, M. J., Mohan, V., Anoop, S., Abhishek, V., Vaidya, R., & Pradeepa, R. (2018). Body fat, metabolic syndrome and hyperglycemia in South Asians. *Journal of diabetes and its complications*, 32(11), 1068-1075. <https://doi.org/10.1016/j.jdiacomp.2018.08.001>
- [65] Puri, P., Shil, A., Shetty, A., Dhar, B., Singh, S. K., Pati, S., & Billah, B. (2022). Contribution of modifiable risk factors on the burden of diabetes among women in reproductive age-group in India: a population based cross-sectional study. *Journal of Public Health Policy*, 43(1), 89-108. <https://doi.org/10.1057/s41271-021-00334-6>
- [66] Salvi, S., Kumar, G. A., Dhaliwal, R. S., Paulson, K., Agrawal, A., Koul, P. A., ... & Dandona, L. (2018). The burden of chronic respiratory diseases and their heterogeneity across the states of India: The Global Burden of Disease Study 1990–2016. *The Lancet Global Health*, 6(12), e1363-e1374. <https://doi.org/10.1016/j.puhe.2014.12.004>
- [67] Yadav, S., & Perianayagam, A. (2020). Mortality Compression and Variability in Age at Death in India. *Comparative Population Studies*, 45. <https://doi.org/10.12765/CPoS-2020-20>