



## The Role of Demography in Human Diseases

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**Abstract:** The Association of demography in health began when the health component was introduced in life tables which allowed calculation of life expectancy. Demographic and epidemiological transitions provide a platform for describing historical experiences on the secular declines in mortality and fertility and associated changes in patterns of disease and causes of deaths from the 1950s to the present day in developed countries. Demographic transition is the secular shift in fertility and mortality from high and sharply fluctuating levels to low and relatively stable ones. Omran (1971) has proposed an epidemiological transition model to explain the relationship between changes in patterns of health and disease and their demographic, economic, sociologic determinants and consequences. By using available evidence, the association of demography with communicable and non-communicable diseases (NCDs) can be analysed in terms of urbanisation, migration and socio-economic status. Urbanisation, migration and socio-economic status influence the spread of communicable diseases, whereas, in the case of non-communicable diseases (NCDs), these variables influence their prevalence and mortality.

**Keywords:** communicable diseases, non-communicable diseases, epidemiology, migration, socio-economic status, urbanisation.

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## Introduction

Demography is the study of the size, territorial distribution and composition of the population, changes therein and the components of such changes (Hauser

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and Duncan 1959 and Yu Xie 2000). Demography is of two types, formal demography and population studies. Formal demography deals with fertility, mortality, age structure and spatial distribution of human populations. Formal demography is founded on the principles of mathematics and employs tools such as life tables and stable population theory. To handle the heterogeneity of population, it divides populations into sub-populations. Population studies lay emphasis on population composition. Population studies borrow methods from social sciences and employ survey methods and statistical tools such as path analysis, structural equations, log-linear models, economic and historical models. The academic boundaries between the two sub-disciplines are not watertight (YuXie 2000).

### **Material and Methods**

This article is based on secondary data. We searched through the online search engine 'Google' using the keywords 'anthropology and demography', 'association of demography with health', 'demography and communicable disease' and 'demography and non-communicable diseases' for information on the role of demography in human diseases. We restricted our search to publications in English only. Source of information includes 'original articles', books and working papers. After the collection of literature, the content was analysed and presented as a review article.

### **Anthropology and Demography**

Anthropological demography is a sub-discipline in demography that uses anthropological theory and methods for a better understanding of demographic phenomena in current and past populations. The main themes covered under anthropological demography are kinship, culture, gender, power, meanings and institutions. Anthropological demography uses both qualitative and quantitative methods, ethnographic fieldwork, participant observation, secondary data and historical material (Bernardi 2007).

### **Association of Demography with Health**

The contribution of demography in health commenced when the health element was introduced into the life tables, which allowed the calculation of life expectancy. Calculation of disability-free life expectancy in the UK, and collection of health and functioning data in China allowed estimation of functional dependency of old people. Initial health models laid emphasis on disease, whereas current models are giving importance to social factors.

First disability classification gave importance to disablement of process from diseases and impairment to a disability, while second disability classification stressed on the equal role of environmental barriers (Robin [www.eLOSS.net](http://www.eLOSS.net)).

Life expectancy increased from 47 years in the mid 20th century to 70 years, today and is projected to increase up to 76 years by the middle of the 21st century. Individually, in terms of population, the proportion of people aged increased from 8 per cent in the middle of the 20th century to 12 per cent and is expected to increase by 21 per cent by the middle of the 21st century (Leeson 2014). Increased life expectancy is attributed to improvement in living standards, control of infection, reductions in infant, child and elderly mortality and decreased death rates due to cardiovascular diseases and cancer (Wilmoth 2000).

### Demographic and Epidemiological Transition

Demographic and epidemiological transitions provide a platform for describing historical experiences on the secular declines in mortality and fertility and associated changes in the patterns of disease and causes of deaths from the 1950s to the present day in developed countries (Santosa *et al.* 2014). The idea of demographic transition was given by Notestein in 1945 and the word 'transition' appeared in the book entitled "La Revolution Demographique" authored by Adolphe Lanry in 1934 (Kirk 1996). Demographic transition is the secular shift in fertility and mortality from high and sharply fluctuating levels to low and relatively stable ones. According to this theory, mortality decline is followed by a decline in fertility which leads to changes in growth rates, size and age distribution and this trend continued for decades. The transition was experienced in many European countries and parts of America over a century and will happen in most of the current world (Lee and Reher 2011).

Researchers (Omran 1971; Agyei-Mensah and de-Graft Aikins 2010) have proposed an epidemiological transition model to explain the relationship between changes in the pattern of health and disease and their demographic, economic, sociologic determinants and consequences. Omran (1971) has proposed three stages of epidemiological transition but later two more stages were added to this model. The first stage is known as the age of pestilence and famine in which high death rates maintained the minimum population. The second stage is the age of receding pandemics characterised by less frequent epidemics and fewer deaths due to communicable diseases. Age of degenerative and man-made diseases is considered as the third stage which is contributed by social factors such as lifestyle, diet, occupation and income. The

fourth stage is termed the age of delayed degenerative diseases in which third-stage diseases dominated but medical technology interventions lengthened the life span of people suffering from degenerative diseases. The fifth stage titled the age of emergent and re-emergent infections is characterised by resurfacing of both old and new communicable and parasitic diseases (Agyei-Mensah and de Graft Aikins 2000). In India, researchers have focussed on demographic transition due to the available data from sample registration systems on fertility, mortality and population growth. Indian states have transformed from high mortality conditions in the 1950s to medium and low mortality conditions for the last three decades (Yadav *et al.* 2014).

### **The Role of Demography in Communicable and Non-communicable Diseases Communicable Diseases**

Based on the available evidence, the association of demography on communicable diseases is analysed in terms of urbanisation, migration and socio-economic status (SES). As per United Nations, 3.9 billion of the world population (54%) are in urban areas. By 2050, the urban population is expected to rise to 6.3 billion (Carl-Johan Neiderud 2015 and Alirol *et al.* 2010). There is no universal definition for the term 'urban'. The working definitions are, living in the capital, economic activities in the region, population size and or even density (Carl-Johan Neiderud 2015). Urbanisation occurs due to natural population growth, migration, government policies, infrastructure development, globalisation and major economic and political forces (Alirol *et al.* 2010).

The effects of demography on urbanisation, migration and socio-economic status on communicable diseases are specified below:

**Urbanisation:** Various features of urbanisation are responsible for the spread of communicable diseases: overcrowding and increased share of air space to tuberculosis, measles, and influenza; overcrowding, unsafe water and inadequate sanitation to diarrhoea, cholera, helminthiasis; lack of sewerage systems and accumulated waste cause proliferation of rodents and increased interface of human and rat leading to diseases like leptospirosis, bubonic plague, typhus, rat-bite fever, bacteraemia, endocarditis, myocarditis, hantavirus hemorrhagic fever with renal syndromes and angiostrongyliasis; overcrowding, bad sanitation and draining facilities to lymphatic filariasis; poor sanitation to visceral leishmaniasis; contact of populations with zoonotic cycles of nearby rural areas to cutaneous leishmaniasis; blood transfusion and organ transplants to chagas disease; dwellings of flimsy and scrounged

material to trypanosomiasis; differential access to medication to multidrug resistance tuberculosis; decreased social cohesion, new family structures and relaxed traditional cultural norms to sexually transmitted diseases; poor housing, overcrowding and close contact of domestic animals to chagas disease; high population density to chikungunya; interruption of immunisation, population movement and urbanisation to yellow fever; low herd-immunity, high population density, increased mobility, air travel, unplanned urbanisation and ineffective control to dengue fever; urban farming and malaria; and closer contacts between humans and fruit bats to ebola (Carl-Johan Neiderud 2015 and Alirol *et al.* 2010). Knowledge on food storage, waste management, vector control and sanitary facilities reduce the burden of communicable diseases in urban areas (Carl-Johan Neiderud 2015).

Urbanisation has been shown to reduce certain communicable diseases. Decreased transmission of malaria and hepatitis-A due to urbanisation was observed. The mechanisms postulated for decreased malaria transmissions in urban areas were increased water and air pollution which reduce vector proliferation, intolerance of *Anopheles* species to polluted water, destruction of vector habits, improved housing conditions and increased access to preventive and curative measures. In the case of hepatitis-A, improved socio-economic status was attributed for its decline (Alirol *et al.* 2010).

**Migration:** People migrate from one place to another for better opportunities, good quality of life, in case of natural calamities, social unrest, wars, ethnic cleansing, genocide, conflicts and political reasons (Alirol *et al.* 2010; Carl-Johan Neiderud 2015; Ghushulak and MacPherson 2004; Soto 2009). Migration affects the transmission of communicable diseases through the migration of infected migrants (e.g. malaria), increased infection transmission by the arrival of infected migrants (e.g. Hansen disease), changing of the epidemiology of communicable diseases in the urban area due to the migration of individuals from non-endemic areas, migration of individuals from areas where immunisation is less comprehensive to areas where immunisation is effective (e.g. polio, hepatitis B, mumps, measles), spread of latent forms of disease (e.g. leishmaniasis) and acquiring of the severe form of disease than natives by immune incompetent migrants, migration of people with animals which create suitable environment for the proliferation of communicable diseases, and international travel which spreads infections such as severe acute respiratory syndrome (SARS), dengue and Ebola, chikungunya, Chagas disease, traveller's diarrhoea, antibiotic resistant *Staphylococcus aureus*, faecal colonisation with *Enterobacteriaceae* and international sports events like

Olympics, Soccer, etc., large religious gatherings like Hajj, environmental changes (flood, drought, earthquake, famine, deforestation, global warming and climate change), zoonotic, non-zoonotic (person-person and faecal-oral transmission) diseases, alcoholism, body piercing, tattooing, intravenous drug use, change in eating habits (bushmeat consumption) and introduction of new plant vectors or new insects (Alirol *et al.* 2010; Carl-Johan Neiderud 2015; Ghushulak and MacPherson 2004; Soto 2009; Linda and Grace 2015; Mackey *et al.* 2014). Imported communicable diseases are classified as cosmopolitan imported diseases (e.g. HIV) when the distribution of communicable diseases is global and tropical imported diseases (e.g. schistosomiasis) when the communicable diseases are restricted to the tropical and subtropical areas (Soto 2009).

**Socio-economic status:** Socio-economic status (SES) is measured based on individual and community level education, income, wealth, employment and family background compared to other individuals or groups (Newman *et al.* 2015). Lower educational status, lower occupational class and living in deprived areas were found to be associated with increased risk of chlamydia infection. A higher risk of Chlamydia infection was observed in women than in men. Chlamydia infection was found to vary by geography and residence status. The reasons outlined for the higher risk of Chlamydia infection in low SES were low perceived benefits of safe sex, reduced consistency of condom use, increased risk factors of unsafe sex such as substance abuse, mental health problems and age gap between sexual partners (Crichton *et al.* 2015). Greater susceptibility and worse outcomes in communicable diseases were observed in people with low SES. Increased incidence of campylobacteriosis, salmonellosis and risk of *E.coli* infection (particularly in Japanese) in people with high SES, whereas, listeriosis, diarrhoea and, acute gastroenteritis in individuals with low SES was observed (Newman 2015). Lower participation of marginalised people in interventions on individual health behaviour changes to prevent HIV or early detection of cancer was reported. Economic inequality in the prevalence of tuberculosis, cervical or gastric cancer was observed. It was also noticed that higher-income than lower-income women were beneficiaries of the cervical screening programmes (Semenza 2010).

During the economic crisis in countries of the former Soviet Union and eastern European countries, increased incidence, mortality and drug-resistant tuberculosis, HIV, an outbreak of diphtheria, tick-borne encephalitis and leptospirosis were observed (Suhrcke *et al.* 2011). The postulated mechanisms for increased communicable burden during the economic crisis were lower

economic standards leading to overcrowding, poor nutrition, reduced immunity and increased stress levels. Communicable diseases cause worse economic conditions. It was observed that in sub-Saharan countries, HIV caused economic instability and severe acute SARS reduced 2 per cent of GDP. A strategy to identify and treatment of high-risk people (prisoners, migrants and homeless) may help in reducing the burden of communicable diseases (Suhrcke *et al.* 2011). Increased irrigation was found to increase vector-borne pathogens such as Japanese encephalitis (Lindah and Grace 2015).

World Health Organisation has enlisted 17 diseases as Neglected Tropical Diseases (NTD). These are dengue, rabies, trachoma, Buruli ulcer, endemic treponematoses, leprosy, chagas disease, human African trypanosomiasis (HAT), leishmaniasis, taeniasis/cysticercosis, dracunculiasis, echinococcosis, food-borne trematodiases, lymphatic filariasis, onchocerciasis, schistosomiasis, and soil-transmitted helminthiasis. Poor housing, poor sanitation, rapid urbanisation, global warming, lack of vector control, public health and social infrastructure failure, travel and outdoor occupations such as farming are considered major risk factors for NTD. Communicable diseases such as HIV, hepatitis, gonorrhoea and syphilis were attributed to human mobility and behaviour. NTD has been shown to decrease economic productivity, cause societal disruptions (political instability, civil strife, stigmatisation) and destabilise local communities (Mackey *et al.* 2014).

### **Non-communicable Diseases (NCDs)**

Based on available evidence, the association of demography on NCDs are examined in terms of urbanisation, migration and socio-economic status.

**Urbanisation:** Unplanned urbanisation is responsible for lifestyle consisting of unhealthy nutrition, reduced physical activity and tobacco consumption and these, in turn, lead to the development of risk factors like hypertension, diabetes mellitus, dyslipidaemia and obesity (Allender *et al.* 2010). Urban living was found to be associated with physical inactivity, high body mass index and diabetes mellitus (Allender *et al.* 2011). In developing countries such as Mexico, South Africa, Malaysia, Thailand, India and Tanzania, the existence of risk factors of non-communicable disease (diabetes mellitus, obesity and hypertension) were observed. With increased urbanisation, the shift of manually intensive occupation (farming, mining and forestry) to less labour oriented white-collar jobs occurred, while, the diet became predominantly sourced from animals. Increased consumption of high energy density foods and sugar-rich soft drinks resulted in a higher proportion of obese people.

Increased usage of motorised transportation and the entertainment activities such as television watching, reduced physical inactivity. Ten years of residence in an urban environment was shown to promote overweight, high fasting glucose and high blood pressure (Allender *et al.* 2011).

**Migration:** Migration from rural areas to urban areas and consequent exposure to motorised travel, pollution, physical inactivity, easy access to tobacco, alcohol and fast food increases the risk for NCDs when compared to urbanites (Oyeboe *et al.* 2015). Migration is considered a major risk for obesity and diabetes in South Asians. Higher cause-specific mortality due to stroke, diabetes and cancer was observed in immigrants. South Asian migrants to UK and Wale were found to have higher mortality due to cardiovascular disease than local populations. A higher risk of nasopharyngeal and liver cancer in Asian migrants than local Australian nationals was observed. A four-fold higher prevalence of diabetes was found in Asian migrants to the UK than other European populations (McLennan and Jayaweera 2014).

**Socio-economic status:** NCDs earlier were prevalent in affluent countries now exceedingly more than a communicable disease in low-income countries with the exception of Africa and responsible for 82 per cent of premature deaths. High risk of cardiovascular diseases, lung and gastric cancer, type 2 diabetes and chronic obstructive pulmonary disease (COPD) was observed in people with low SES and residents of low and middle-income countries. Higher mortality risk due to lung cancer, COPD, reduced survival in breast cancer patients and higher prevalence of obesity among low SES people in high-income countries was noticed; while in middle-income countries, lower case fatalities of stroke and higher survival of retinoblastoma patients was found when compared to low-income countries. Tobacco use, physical inactivity, alcohol abuse and an unhealthy diet are considered to be the common risk factors for NCDs. These risk factors are associated with four disease clusters such as cardiovascular diseases, cancers, COPD and diabetes, and are responsible for 80 per cent of deaths due to NCDs dominated by cardiovascular diseases. It was estimated that by 2030, 70 per cent of deaths would occur due to NCDs. Increased risk of stroke in East Asians, whereas, higher risk of coronary heart disease in South Asians, was observed. In high-income countries, providing technology-intensive health care for the aged, whereas, in low-income countries providing protection by insurance has become challenging (Hunter and Reddy 2013).

Increased prevalence of chest pain, arthritis, asthma and depression was observed in a person with low income and education. Increased risk of myocardial infarction and type-2 diabetes and increased rates of stroke incidence was



observed in persons belonging to low SES (Sommer *et al.* 2015). Higher smoking and low consumption of fruits and vegetables were observed in people with low SES. Tobacco companies though reduced marketing strategies in developed countries but intensified in low and middle-income countries. Less leisure-time physical activity and more work-related physical activity was observed in people with lower than higher SES (Hosseinpour *et al.* 2012). Self-reported prevalence of NCD was found to be higher in affluent people, whereas diagnosed NCD by standard measures was observed to be higher among people with low SES in various studies and this was hypothesised to lack of access to health care and under-diagnosis in people belonging to low SES (Vellakkal *et al.* 2013).

## Conclusions

The role of demography in health began with the introduction of health elements in life tables. Demography influences health through factors such as urbanisation, migration and socio-economic status. Our review suggested that demographic factors play an important role in the causation of communicable as well as non-communicable diseases. Policymakers need to make a note of the evidence on the role of demographic factors in both communicable and non-communicable diseases for preparing strategies on the control and prevention of diseases. Efforts have to be made to identify the barriers of health-seeking behaviour and availing the access to health care particularly among members of low socio-economic status to realise the dream of 'health for all'.

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