

**The Encyclopedia of Life Support Systems (EOLSS)**  
Coordinated by the UNESCO-EOLSS Joint Committee

***Demography***

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## PREFACE

According to the classic and widely accepted statement by Hauser and Duncan (1959), *demography* is defined as “the study of the size, territorial distribution, and components of population, changes therein, and components of such changes.” Almost all disciplines of social sciences and most disciplines of natural sciences deal with human beings in one way or another, either directly or indirectly. Furthermore, demographic concepts (e.g., birth rate, death rate, and migration) and methods and analysis strategies (e.g., life table analysis) can be readily extended to other species (insects, animals, plants, etc.) and inanimate collectives (enterprises, automobiles, etc.). Clearly, demography is an important thematic field in science and it may provide the empirical foundation for studying human beings, animals, and inanimate collectives on which other relevant scientific research is built.

The practical needs of human populations in the past several decades, both global and domestic needs requiring demographic research, have strongly promoted the quick development of methodologies and empirical applications of demography. Such human needs include slowing down the rapid population growth to enhance economic development by promoting family planning programs in developing countries in the 1950s, 1960s and 1970s; understanding the second demographic transition which is characterized by weakening of the family institution through an increase in divorces, decrease in marriages with increase in cases of cohabitation, and tremendously declined and delayed fertility in the recent decades; facing the serious challenges of population aging, especially the rapid increase of the oldest-old who may likely need daily care assistance; as well as addressing global health with a main concern of the quickly enlarging inequalities in health services facilities and health outcomes between the developed and less developed worlds regarding reproductive health, HIV/AIDS, chronic diseases, and disability among elderly, etc. Moreover, the rapid increases in population data sources and computing technologies have also stimulated the quick growth of demography. Consequently, for the first time in the multi-discipline and multi-volume general encyclopedias for broad audiences of non-experts and experts, The Encyclopedia of Life Support Systems (EOLSS) under the auspices of UNESCO includes “*Demography*” as a distinct volume, which may be regarded as an indicator that the world community recognizes demography as an important and distinct discipline of science.

Following the introduction essay which summarizes the past, present and future of demography, each of the 22 chapters covers a sub-field of demography in depth and contains relevant and necessary details reviewing the established knowledge associated with them. The 22 sub-fields include: Historical Demography, Demographic Transition, Fertility Trends and Implications, Sexual Behavior and Reproductive Health, Family Planning and Reproductive Health, Mortality Patterns and their Implications, Sex and Sex Structure, Anthropological Demography, Health and Demography, Economic Demography, Applied Demography: Its Business and Public Sector Components, Demography of Aging, Biodemography, Family and Household Demography,

Demographic Models and Actuarial Science, Multistate Demography, Mathematical Demography, Urbanization and its Consequences, Population Geography, Population and Natural Resource/ Environment, Population Policy, Population Projections and World Population Trends.

The volume is expected to be of value to the various audiences of both non-specialists and experts who seek a comprehensive understanding of issues related to human population. As reviewed in the very beginning of the Theme Introduction, “interdisciplinarity” is one of the three major features of demography. Given the rapid development in techniques for collecting not only demographic data but also other related data concerning health, biomarkers, genetics, behaviors, and social and natural environments in conventional population surveys, as well as rapidly enhancing computing powers, this volume shows and concludes that demography will be even more interdisciplinary in the coming decades. A notable example is that the cross-field “marriage” between bio-medical sciences and demography will lead us to enter an era in which bio-medical and demographic methods will be well integrated. As indicated by Carey and Vaupel in the chapter on “*Biodemography*” here, the bio-demographic branches of demography are vibrant areas of demographic research that are rapidly growing and that have great potential to enrich and enlarge the domain of demography. Not only can demographers learn much from biologists and epidemiologists, but they can also contribute much to research on life in general and population health in particular. The increasing availability of data sources and much enhanced computing/internet power will also lead demography to be more interactive with the other fields, such as psychology, environmental science, economics, business and management, etc. As discussed in “*Applied Demography: Its Business and Public Sector Components*” by Swanson and Pol, for example, it is now possible to link conventional demographic data sources of census, surveys, and vital statistics with administrative records such as social security, tax reporting, medical insurance, hospital records, school registration, supermarket purchasing cards use, etc., while protecting individuals’ privacy. Such linkages will substantially increase the value of demographic methods, censuses, surveys and administrative records for scientific research and policy analysis, as well as the applicability of demography in business and governmental decision making processes.

I would like to sincerely thank the authors of all of the 22 chapters who have made outstanding contributions to this *Demography* volume; without their scientifically effective and serious efforts, this work would never be completed. I am extremely grateful to the following experts (listed alphabetically) who generously spent significant amounts of their time to read/review and raise thoughtful comments on the chapter assigned to them: E. Aahman, M. Alam, T. Bengtsson, R. Bilsborrow, J. Bongaarts, E. Cambois, T. Cooke, Alex de Sherbinin, S. De Vos, M. E. Dupre, J. Ermisch, R. Fernando, A. Hayes, V. Kandiah, N. Keilman, D. Kertzer, K. Kinsella, E. Kraly, R. Lee, S.P. Morgan, M. Muszynska, S. Preston, V. Raveis, S. Reynolds, N. Riley, J. Sell, V. Shkolnikov, R. Shoen, R. Smith, C.M. Suchindran, J. Tayman, D. van de Kaa, F. Willekens, Deqing Wu, Yu Zhu, F. Yusuf, Zeng Yi, Z. Zhao, Z. Zheng, and Yun Zhou. . I also wish to express my sincere thanks to the UNESCO-EOLSS Joint Committee and

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Zeng Yi,  
Honorary Theme Editor, *Demography* Volume of UNESCO-EOLSS  
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## **Bibliography**

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## **Chapter 0 DEMOGRAPHY: the Past, Present and Future**

**Zeng Yi**  
Duke University and Peking University

### *Contents*

1. Demography as a Discipline of Science
  2. Historical Evolution of Demography and Population Theories
  3. Demographic Data Sources and Recent Progress
  4. The Demographic Methods
  5. Challenges and Future Perspectives of Demography
  6. Concluding Remarks: Demography will be More Interdisciplinary
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### *Summary*

As the theme introduction, this essay begins with a brief discussion about “What is demography” in general and what are *formal demography* and *population studies* in particular. The three distinct features of demography are summarized as: (1) *Mostly quantitative and relatively more “accurate.”* (2) *Interdisciplinary.* (3) *Applicable.* The author also emphasizes what is new in this EOLSS volume of Demography, as compared to other existing similar publications. After a review of the historical evolution of demography and the main streams of population theories, the author presents the major demographic data sources of vital statistics, census, sampling surveys, and administrative records. The author devotes some particular attention to the American Community Survey (ACS), which represents the most substantial and innovative reform of the traditional censuses in the 1990s. The author also highlights the recent extensions of the data content in demographic surveys, namely, demographic data collections have been evolving from merely including demographic, socioeconomic and behavioral information to also including health, environmental, biomarkers and DNA information. While the author presents the promising progress in openness of demographic data sources in North

America, Europe and Australia, he expresses worries about the unreasonable and unnecessary distribution restrictions of the demographic data sets in Japan, China, India, and many other developing countries. In these many countries, the census sampling data sets and the national survey data sets are not made publicly available; it is very hard for a researcher to get access to the data sets. Such a situation is very unfortunate for broad and in-depth analyses of the data in scientific research and policy studies. This is also unfair for the tax payers who share the costs of the data collections. The author thus suggests initiating a global discussion about the openness of demographic data, while at the same time effectively protecting individuals' confidentiality.

The essay briefly discusses the fact that demographic analysis usually employs simple or modest mathematical methods, with a few exceptions for some models in mathematical demography. The basic methodological characteristics of formal demography and population studies are summarized in an easily understandable way.

Finally, the author discusses the challenges and future perspectives of demography in the following five aspects, which are also the major challenges currently faced by global communities: (1) Rapid population aging due to low fertility and longevity; (2) Changes in family; (3) Gender equality, son-preference and rising sex ratio at birth in some developing countries; (4) Demographic consequences of migration in both origination and destination regions; (5) Population and environmental sustainability; (6) Global health including reproductive health, HIV/AIDS and healthy aging.

## **Chapter 1 HISTORICAL DEMOGRAPHY**

**Zhongwei Zhao**

*Australian Demographic and Social Research Institute, Australian National University, Australia*

### ***Contents***

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  3. Major Data Sources for Historical Demography
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  5. Concluding Remarks: Historical Demography at the Beginning of the Twenty-first Century
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### ***Summary***

Historical demography is an important component of demography. Its aim is to obtain detailed information about population changes and people's demographic behavior in the past through applying demographic methods to historical data. Since its establishment as

an academic discipline in the mid-twentieth century, historical demography has advanced at a rapid pace and made significant contribution to the development of demographic theories and to our understanding of population changes in both historical and contemporary societies.

This chapter starts with the definition of historical demography, its relationship with demography and demographic history, and main reasons why historical demography established itself so rapidly in the 1950s. It then summarizes major developments in historical demography since the 1950s. Following that the primary data sources available to historical demographers and some methodological developments made in historical demography are discussed. The chapter concludes with comments on the likely future challenges and opportunities for advancing historical demography in the world.

## **Chapter 2 DEMOGRAPHIC TRANSITIONS**

**Dirk J. van de Kaa**

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### ***Contents***

1. Introduction
2. The First Demographic Transition (FDT) and its precursors
3. The Second Demographic Transition (SDT) and its precursors
4. A Schematic Representation of the Two Transitions
5. Explaining the First Demographic Transition
6. Explaining the Second Demographic Transition
7. Transitions in Context
8. Criticisms and Support

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### ***Summary***

In the history of humankind few innovations have been as important as that of the voluntary control of fertility. When in Western Europe in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries its effects on the birth rate and population change first became apparent it was recognized as a truly revolutionary event. And indeed, in France it came to be called the ‘demographic revolution’. Internationally that term did not find favor and was replaced by ‘demographic transition’. This chapter discusses the classical, now First Demographic Transition (FDT) by tracing the history of the concept, by considering its determinants and its spread across the world. However, it also discusses the Second Demographic Transition (SDT), a further important change in demographic regime that appears to have started in the same part of the world just after the mid-1960s. That transition is also spreading to other regions and appears to affect populations that have reached high levels

of socioeconomic development where contraception is perfect and where the close link between sexuality and procreation no longer exists.

As discussed in this chapter the determinants of both transitions are changes in the structure, culture, and technology of societies. But, there is a certain shift in emphasis. Socioeconomic development and a decline in mortality appear to have been prerequisites for the onset of the FDT although it has affected countries that differ widely in social structure, political system and economic system. Once started the FDT in a country usually continues. It may be aided by family planning programs or government policies and occasionally stalls when countries began the transition when they already had low fertility relative to their level of development.

While the proponents of the idea of a SDT stress that the changes in economic and technological conditions (pill) remain important determinants of that transition they tend to highlight the role of ideational change. As explained in the chapter ideational shifts appear to have changed people's attitudes towards marriage, childbearing, the responsibility for one's own health, and demographic change more generally. Since people highly value each individual's freedom of choice and seek self-fulfillment in work and relationships the level of fertility typically declines to very low levels.

### **Chapter 3 FERTILITY TRENDS AND IMPLICATIONS**

**Hans-Peter Kohler**

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Philadelphia, PA 19104-6299, USA*

#### ***Contents***

1. Introduction
  2. Fertility Trends: Past and Present
  3. Theoretical Frameworks
  4. Looking Forward: The Future of Low Fertility
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#### ***Summary***

Fertility decline and fertility change in both developing and developed countries is a social change of essential importance. The divergence of mortality and fertility levels in the 2nd half of the 20th century has given rise to a rapid growth in the world population. More recently, below replacement fertility has spread from developed to developing countries, and in some developed countries, very low fertility has emerged as a prominent policy concern. In all contexts, fertility change is perceived as a central issue in a range of global and national concerns. At the same time, the fertility change underlying these problems has puzzled generations of researchers: alarmist perspectives, pessimism, optimism and revisionism have characterized the tides of the population debate. Moreover, as the world populations have entered the 21st century, the new challenges presented by very low fertility and its implications for the family and population aging

have reinvigorated research on fertility but without necessarily resolving long-standing differences in the assessment of the causes, implications and policy responses to fertility change. New data and empirical analyses of both historical and contemporary fertility declines have weakened the standard theory of demographic transition, and the rise of low and in particular, very low fertility has challenged many theoretical frameworks that provided the workhorses of theorizing about fertility change during the 2nd half of the 20th century. This chapter reviews the key past and current trends in fertility in developed and developing countries, outlines the main theoretical frameworks that are used to explain changes and differences in fertility and discusses some new integrative approaches, and it concludes with a discussion of the future of low fertility, which has emerged as a defining theme and challenge to contemporary work on fertility.

## **Chapter 4 SEXUAL BEHAVIOR AND REPRODUCTIVE HEALTH**

**Elwood D. Carlson**

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## *Summary*

Reproductive health includes factors that influence the ability of men and women to produce healthy offspring. Just as health may influence sexual behavior and reproduction, sexual behavior may have a reciprocal impact on health. Health limitations on sexual activity include age effects, disease and disability as limitations of sexual activity, behavioral complications, and effects of medical treatment. Effects of sexual behavior on reproductive health include adverse pregnancy outcomes (spontaneous loss, prematurity and low birth weight) as affected by timing of sexual activity, number of sexual partners, and sexually transmitted disease. Other effects include reproductive impairment, either involuntarily as the result of disease or complications of pregnancy and delivery or voluntarily in the case of sterilization, as well as possible disease and death of adults as a result of sexual behavior. Violent sexual behavior has powerful effects on reproductive health, whether it is experienced early in life or in adulthood, and whether it occurs systematically as in wars and other social upheavals or as hidden deviance involving isolated individuals.

A widely-accepted definition of reproductive health emerged from the International Conference on Population and Development, organized in Cairo in 1994 by the United Nations. At the Cairo conference, reproductive health was defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and to its functions and processes. Reproductive health therefore implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so. Implicit in this last condition are the right of men and women to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice, as well as other methods of their choice for regulation of fertility which are not against the law, and the right of access to appropriate health-care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant. In line with the above definition of reproductive health, reproductive health care is defined as the constellation of methods, techniques and services that contribute to reproductive health and well-being by preventing and solving reproductive health problems. It also includes sexual health, the purpose of which is the enhancement of life and personal relations, and not merely counseling and care related to reproduction and sexually transmitted diseases."

Reproductive health includes factors that influence the ability of men and women to produce healthy offspring. Though all health conditions may influence this ability, here attention centers on economic and social variations in human societies that may influence sexual behavior and reproduction (to the extent that they produce observable demographic consequences in populations) and that may influence variations in the health of mothers and infants during gestation and childbirth. Just as health may influence sexual behavior and reproduction, sexual behavior may have a reciprocal impact on health.

## **Chapter 5 FAMILY PLANNING AND REPRODUCTIVE HEALTH**

**Iqbal H. Shah**

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### **Contents**

1. Introduction
2. Family Planning: Levels and Trends in the Use of Contraceptive Methods
3. Reversible Contraceptive Methods: Discontinuation and Switching
4. Family Planning and Induced Abortion
5. Family Planning in the Era of HIV/AIDS
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### **Summary**

This chapter focuses on family planning in the context of reproductive health. It brings together the evidence on the levels and trends in the use of family planning methods by area and region. The realization that human fertility can be regulated by using family planning methods and the speed with which this knowledge was put to practice by millions of people worldwide are perhaps the most remarkable achievements since the 1960s. Family planning is a key to attaining sexual and reproductive health, but it also impacts on social and economic development.

Family planning methods are varied - some are permanent and the others are reversible. Some of the methods are classified as modern while the others are traditional. The continuation of use and the switching between various types of methods is insightful to assess the implications of contraceptive used patterns for unintended pregnancies. The chapter also considers the relationship between contraceptive use and induced abortion. Family planning in the era of HIV/AIDS requires revisiting and adapting the guidance on family planning and developing new strategies to meet the needs of people living with HIV/AIDS. The critical role that family planning plays as one of the elements of reproductive health has also been documented in the chapter.

## **Chapter 6 MORTALITY PATTERNS AND THEIR IMPLICATIONS**

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### **Contents**

1. Introduction
2. The Variety of Situations Today
3. The End of the Third World Concept
4. The Stages of Health Transition
5. What Assumptions for the Future?

- 6. Divergence and Convergence
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- 8. Conclusion
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- Bibliography
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### ***Summary***

The diversity of mortality levels and patterns around the world is currently greater than ever. This directly results from the new historical perspective engaged two and half centuries ago, when some North-Western European countries started to become efficient in their fight against disease and death. But the road of progress has not been straightforward. Until the late 1960s, it was possible to rather clearly oppose high mortality levels of developed countries to the low levels of developing ones. Today, both groups of countries radically split into those that were the most successful and those that lagged behind. Many authors, starting with Abdel Omran and his epidemiological transition theory tried to find out the rationale for the historical mortality changes, and continuing with those who tried to extend Omran's theory to the new facts that contradicted it and with those who preferred to try to assess a new theory, the health transition theory, to take into account non-epidemiological factors. However the current situation is so complex that it is not possible to describe it as the result of only one stream of changes that could universally explain all the different trajectories of individual populations. It appears that the history of human mortality is made of the achievement of successive steps of development that occurred with quite different timing from one population to another, in order to produce at each step a divergence and then convergence wave. And a wave can easily start when the previous one is not completed. Thus explained, the large to-day inequity is far from being reduced. That would need that the most advanced population be stopped in their progress by a supposed biological limit of the human life span-a limit that nothing allows us to fix today.

### **Chapter 7 SEX AND SEX STRUCTURE**

**Dudley L. Poston, Jr., Bethany S. DeSalvo, and Heather Terrell Kincannon**  
*Texas A&M University, USA*

#### ***Contents***

- 1. Introduction
- 2. The Importance of Sex and Sex Structure for Demography
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## ***Summary***

In this chapter we argue that sex structure is one of the most important and relevant features of human societies. Regarding demographic study, the interaction of sex structure with the three demographic processes is of paramount importance. But the importance of sex structure extends far beyond demography. A society's sex structure has important implications for socioeconomic and demographic development, as well as for labor force participation and gender relations. Accordingly, we first examine the importance of sex and sex structure for demography. We next consider the definition and classification of sex. Then we discuss the major demographic measures of sex structure. This is followed by a discussion of the population pyramid. We conclude the chapter with two detailed substantive demographic analyses of unbalanced sex structure, namely sex structure and the labor force and the sex ratio at birth.

## **Chapter 8 ANTHROPOLOGICAL DEMOGRAPHY**

**Laura Bernardi**

*Max Planck Institute for Demographic Research and Rostock University Germany*

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  4. Methodological Challenges: Combining Fieldwork and Statistical Approaches
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### ***Summary***

Anthropological demography has grown from the interest of demographers in socio-cultural anthropology theories and methods applied to demographic phenomena. We delineate the birth of such sub-discipline within demography and review the major contributions by anthropologists and by demographers to the field. We then address the theoretical contributions that anthropological demography has brought to population studies through the specification of fundamental concepts like culture, gender, and political economy, as well as their inclusion in explanations of demographic behavior. In the second part of the chapter, we use selected case studies in the domain of fertility, mortality, and migration to illustrate the empirical research approach used by anthropological demographers. This is the occasion to discuss the challenges of integrating data and analytical perspectives across disciplines and the advantages of mixed methods. Finally, we conclude by indicating a few directions towards which

research in anthropological demography could develop: on a theoretical level the integration of institutional demography and political economy with the concept of agency, on an empirical level more research directed to population phenomena in post industrial societies.

## **Chapter 9 HEALTH AND DEMOGRAPHY**

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**Carol Jagger**

*Department of Health Sciences, University of Leicester*

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1. Introduction: The overlap between Health and Demography
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### ***Summary***

The connection between health and demography is complex. Whilst demography is essentially a scientific discipline, health is a wide ranging concept. In this chapter we attempt to describe the main issues on health useful to demographers. After a brief introduction, Section 2 discusses the various ways that health has been understood and measured from different standpoints: clinical, functional and sociological as well as the more recent evolution of the notion of frailty. The major classification systems for diseases and disability are then described. In Section 3 we describe different ways in which health data is collected and the main issues concerned with the principal method that concerns demographers: the health survey. Section 4 reviews the basic population health indicators in use by epidemiologists (prevalence, incidence and mortality) and extends this to a composite summary measure, health expectancy, combining information on mortality and morbidity. The history of health expectancies is then described and how they are being used to monitor population health within Europe and the US today. In the final section we explore research questions in a specific health expectancy, that of disability-free life expectancy.

## **Chapter 10 ECONOMIC DEMOGRAPHY**

**C.Y. Cyrus Chu**

***Contents***

1. Introduction
2. The Classical Malthusian World
3. Marriage and Modern Family
4. Family Fertility Behavior
5. Population Dynamics and Cycles
6. Intergenerational Transfers
7. Conclusions

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***Summary***

This Chapter addresses selected topics where economics and demography intersect and interact with each other. We start with the Malthusian model, where the population size is constrained by the economic carrying capacity. In this classical model, technological changes only increase the equilibrium population size, but not the wage level. After the industrial revolution, improved hygiene and medical knowledge have reduced the mortality rate, and the ensuing fertility transition has been characterized by a fertility rate decrease and an increase in parental investment in children, within the financial capability of the parents; a phenomenon known as a quantity-quality tradeoff by researchers. For poor families, however, children are still treated by their parents as labor help, especially in agricultural countries. This dichotomy of family behavior in well-to-do and poor countries has created some global economic problems related to family fertility decisions.

The demographic transition has affected the economic behavior at both the micro and the macro levels. At the micro family level, economic modernization after the industrial revolution has increased the age of first marriage, lessened the characteristic asymmetry of the couple, and increased cross marriages. At the macro level, the demographic transition has also created various fertility cycles and population ageing. These phenomena are then compared with the traditional dynamics of population theory, such as predator-prey cycles, dynastic cycles, and capitalism cycles. Finally, since the period of child dependency is long for human beings, parental transfer has also become an important factor in explaining the various features of life history, such as age-specific U-shape mortality, human longevity, and menopause.

**Chapter 11 APPLIED DEMOGRAPHY: ITS BUSINESS AND PUBLIC SECTOR COMPONENTS**

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**Louis G. Pol**

***Contents***

1. Introduction
  2. Business and Public Sector Demography
    - 2.1 Basic Data Sources
    - 2.2 Tools
    - 2.3 Training
  3. Examples
    - 3.1. The Need for a New Medical Facility
    - 3.2. Improving Cellular Market Valuation with Demographic Data
    - 3.3. Determining the Effect of Hurricane Katrina on Medical Practices
  4. Challenges and Opportunities
- Glossary  
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***Summary***

The development of data through estimation and projection (particularly for small areas) has and will continue to be affected by continued improvements in methods and technology. Although focus here is on applied demography in the United States, the developments described in methodology and technology transcend national boundaries and, as such, serve to globalize its key features and practice. These developments will, in turn, influence business demography not only in the United States, but elsewhere. They suggest that even more skills and an expanded demographic perspective will be needed by those with a desire to be successful applied demographers.

**Chapter 12 DEMOGRAPHY OF AGING**

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*Institute of Social and Cultural Studies, University of the Punjab, Research Consultant, University of Gujrat*

***Contents***

1. Introduction and Background
2. Global Ageing: An Overview of Major Trends in Developed and Developing World
3. Rapid Populations Ageing in Developing World
4. Demographics of Ageing: Major Determinants
5. Major Challenges of Rapid Aging for Public Policy
6. Changing Family Structure, Status of Women and Feminization of Aging
7. Problems and Needs of Aging Population

8. Financial and Fiscal Policies for Older Persons
  9. Foreign Assistance and the Role of Civil Society
  10. Growing Concerns for Public Policy in Developing Countries
  11. Recommendations for Action
- Glossary  
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### ***Summary***

According to the UN estimates, declining fertility and increasing longevity are resulting in aging of population in both developed and developing countries which need serious attention of the governments. Worldwide, the number of people aged 60 and over will increase from about 600 million in 2000 to almost 2000 million in 2050. In developing countries as a whole, 60 year and above population is about 8 per cent and will increase up to 28 per cent by 2050.

Successes in reproductive health and family planning programs and improvements in health care services (low fertility and low mortality) have contributed towards population aging by enabling longer survival. Moreover, population aging in developing countries is taking place at a much faster pace than it did in developed world.

The problems posed by aging population constitute economic, social and emotional dependency of the older people. Moreover, elderly population is also likely to be affected by chronic diseases and disabilities. Hence, they pose a heavy burden on the national budgets in terms of their pension, improved living arrangements, health care cost and social needs. These issues have invited policy makers to revisit the old policies and formulate new policies and social protection programs for the aged.

In most developing countries, women constitute at least 55 per cent of the total aging population. Old women experience old age, mostly as dependents and vulnerable compared to men. Developing countries need to take urgent steps to address the concerns of aging population and to take preventive measures to ensure healthy and active ageing in the future.

There is a need to evolve a new paradigm to minimize the generation gap between the older people and young generation for social protection and to meet the growing needs of elderly population on priority basis

## **Chapter 13 BIOLOGICAL DEMOGRAPHY**

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### **James W. Vaupel**

*Founding Director, Max Planck Institute for Demographic Research, Rostock, Germany*

### **Contents**

1. Introduction
  2. Biological Demography
  3. Historical Overview
  4. General Biological Demographic Principles
  5. An Emerging Biological-Demographic Paradigm
  6. Biomedical Demography
- Glossary  
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### **Summary**

Biological Demography (Biodemography) is an emerging area of classical demography consisting of two subcategories including biological demography and biomedical demography, the former concerned primarily with the experimental demography of non-human species such as fruit flies, nematode worms, and laboratory rodents, and the latter concerned with health demography of humans. In this chapter we define biodemography, provide a historical perspective of this new field, and outline some of the main principles that have been identified over the last several decades from the results of research from biological demography including the indeterminacy and adaptive qualities of lifespan and the deceleration and sex-specificity of age-specific mortality. At the end we describe briefly the developments in selected new areas within this new field including evolutionary demography, genetic and genomic demography, paleodemography, ecological biodemography, and biomedical biodemography. We conclude that both the biomedical-demography branch of biodemography and the biological-demography branch are vibrant areas of demographic research that are rapidly growing and that have great potential to enrich and enlarge the domain of demography. Not only can demographers learn much from biologists and epidemiologists, but demographers can contribute much to research on life in general (as opposed to humans in particular) and to research on population health.

## **Chapter 14 FAMILY AND HOUSEHOLD DEMOGRAPHY**

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### **Contents**

1. Introduction
2. A Brief History
3. Conceptual and Measurement Issues
4. Profile and Major Trends in Households
5. Household Models

## 6. Discussion and Conclusion

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### *Summary*

Households are groups of people that co-reside and share some resources. Families are households of related individuals. Household and family demography is the study of these primary social groups or social units, and in particular of group membership and the relationships between members of the group. The concepts of household and family depend on cultural, social and economic factors that vary in time and between countries. The conceptual and measurement issues that result are addressed in the chapter. The documentation of changes in households and families and the modelling of these changes represent major challenges in demography. To capture the complexity of households, tabulations of the full array of household relationships replace tabulations of household positions relative to the household head. Household models follow a similar path. Headship rate models that describe household structures from the perspective of the head of household are increasingly being replaced by dynamic models that focus on relationship among members of a household. As a consequence, models of household dynamics change in the direction of models that describe the demographic dynamics of kinship. The chapter reviews the different approaches to the demographic study of households and families, discusses strengths and weaknesses of models, and proposes agent-based models for the description and projection of households and families in varying contexts.

## **Chapter 15 DEMOGRAPHIC MODELS AND ACTUARIAL SCIENCE**

**Robert Schoen**

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### *Contents*

1. Introduction

2. Life Table Models

3. Stable Populations

4. Multistate Population Models

5. “Two-Sex” Population Models

6. Dynamic Population Models

Acknowledgement

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## *Summary*

Population models typically describe patterns of mortality, fertility, marriage, divorce, and/or migration, and depict how those behaviors change the size and age structure of populations over time. Demographic behavior in fixed rate, one-sex populations is quite well understood by means of existing demographic and actuarial models, principally the stationary population (life table), stable population, and multistate models. Progress has been made on “two-sex” marriage and fertility models, though no consensus has been achieved. Work since the mid 1970s has led to a better understanding of timing effects and the relationship between period and cohort measures over time. Generalizations of the stable model that allow changing vital rates are now available, but such dynamic modeling remains in a relatively early stage.

## **Chapter 16 MULTISTATE DEMOGRAPHY**

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### **Zeng Yi**

*Duke University and Peking University*

### *Contents*

1. Introduction
  2. The Multistate Life Table
  3. The Multistate Projection Models
  4. Applications of Multistate Demography
  5. Bridging the Micro- and Macro-Simulation Models: Recent Development of Multistate Demography
- Glossary  
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Biographical Sketches

### *Summary*

This chapter deals with multistate demography, an extension of classic mathematical demography to the case of individuals grouped in various categories of demographic and/or socioeconomic attribute(s) such as marital/union status, labor activity status, region of residence or health status. Individuals can move from and to these categories but -and this the salient feature of multistate demography - they are allowed to return to a state/status previously occupied; a long standing modeling difficulty which was eventually overcome by having recourse to a vector/matrix notation. This exposition, kept as little technical as possible, covers the basic principles of multistate demography, its two main models - that is, the multistate life table and the multistate projection model - as well as the generalization of these models to the case of families. It also alludes to the recent development of multistate demography which tends to bring this subfield of

demography closer to mainstream statistics. Finally, adopting a more empirical viewpoint, it presents several applications of multistate demography to various population areas.

## **Chapter 17 MATHEMATICAL DEMOGRAPHY**

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### **Zeng Yi**

*Duke University and Peking University*

### **Contents**

1. Introduction
2. Models in Demography
  - 2.1 The Nature of Demographic Phenomena and Data
  - 2.2 Introduction to Models
  - 2.3 Mathematical Demography Models
3. Measures of Longevity in the Life Table
  - 3.1 The Mean, Median, and Mode of the Distribution of Deaths
  - 3.2 Lags and Gaps in Life Expectancy
4. Decomposition Methods in Demography
  - 4.1 Standardization and Decomposition Methods
  - 4.2 Decomposition of the Difference of Two Rates
  - 4.3 Decomposing Fertility Measures
  - 4.4 Decomposition of the Change in Demographic Variables
  - 4.5 Life Expectancy Decomposition
  - 4.6 Remarks on Decomposition Methods
5. Models of Mortality Patterns
  - 5.1 The Coale-Demeny Model Life Tables
  - 5.2 Modified Logit Relational Model
  - 5.3 The Lee-Carter Model
  - 5.4 Advantages and Applications of Mortality Models
6. Stable Population Extensions
  - 6.1 Extensions Derived from the Population Growth Rates
  - 6.2 Use of Variable-r Methods
  - 6.3 Population Momentum and Family Household Momentum
7. Modeling Vital Events

- 7.1 Model Schedules and Summary Indices
- 7.2 Age-Period-Cohort Models
- 7.3 Frailty Models
- 7.4 Vital Events and Population Projection
- 8. Indirect Estimation and Evaluation of Data
  - 8.1 Estimation of Child Mortality
  - 8.2 Completeness of Adult Mortality Registration

### **Summary**

Mathematical demography focuses on population phenomena and their relations with other population phenomena. Its subject is not facts as such, but how to handle them. The methods and tools used in the analysis of population phenomena are continually changing, and as a consequence constantly improving our knowledge of population dynamics. New mathematical developments have occurred in the measures used to describe life tables, decomposition methods, model life tables, models of age-specific rates, and indirect methods of estimation. Changes in mathematical demography also include revisions and updates to the basic definitions of model and theory in the context of demography. This Chapter reviews some of the latest developments in the large body of mathematical theory concerned with the growth processes of populations. The topics covered were selected on the basis of elements of mathematical demography that have not been addressed in the rest of the volume. This assessment of the state of the art in mathematical demography complements the rest of the contributions of this special volume on demography. As described in this Chapter, mathematical demography remains central to the discipline as a complete body of methods, models, and theories that are used within many different areas of demography.

## **Chapter 18 URBANIZATION AND ITS CONSEQUENCES**

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### **Yuan Cheng**

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### **Contents**

- 1. Definition and Background
- 2. Urbanization Theories
- 3. Importance Dimensions of Urbanization
- 4. Consequences of Urbanization
- 5. Conclusion
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### ***Summary***

To show a general picture about urbanization and its consequences, we introduce the most common concept of urbanization and review the urbanization history briefly. Dedicated to the development of the urbanization, four mainstream urbanization theories and their respective pros and cons have been discussed.

While urbanization is a powerful "master" process of long historical duration, current vibrancy, and even stronger future impact, it is not monolithic or unidimensional. On the contrary, urbanization carries several important dimensions that collectively and individually produce macro and micro impacts on the society and everyday life. We introduce and explore a number of these dimensions with a heavy demographic emphasis through illustrative research findings and empirical examples, which also help pave the way for us to examine the socioeconomic consequences of urbanization.

While it is not always possible to fully disentangle the mutual causation between urbanization and the other major processes such as population growth, industrialization/deindustrialization, social transformation, and so on, it is forever important and necessary to identify a range of significant consequences of urbanization. Among the many consequences, we select the aspects of environments, job creation, housing, education and health as the spotlight for our discussion. How these consequences may play out in rapidly urbanizing countries that remain less developed and thus less equipped to deal with them are also emphasized.

## **Chapter 19 POPULATION GEOGRAPHY**

**Suzanne Davies Withers**

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### ***Contents***

1. Introduction
2. Population Geography and Contemporary Spatial Demography
3. Methods of Population Geography
4. Themes of Population Geography
5. Challenges and Future Directions

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Biographical Sketch

### ***Summary***

This chapter provides an overview of the field of population geography. Population geography is a subfield of the discipline of geography and a subfield of the discipline of demography. Population geography addresses the spatial distribution, characteristics, and

spatial variation of the population. The importance of a spatial perspective for demographic research has received considerable attention over the past few decades. Population geography addresses demographic issues and population processes in an explicitly spatial manner, with a focus on the connection between people and places. Spatial demography refers to the formal methods used to make these links. Geographic concepts and spatial thinking are described, with particular attention given to the concept of scale.

The chapter reviews the intellectual heritage of population geography and explains the contemporary correspondence between population geography and spatial demography. Conceptions of space and place in population geography are quite sophisticated, and recent advancements in spatial analysis have been enabled by geographic information systems, software development, and the availability of spatially explicit data (geocoded) sources. A host of methods of population geography are detailed, giving particular attention to the recent development of local, as opposed to global, measures of spatial analysis. Methods are reviewed for the study of geographic distribution, population movement, and spatial analysis.

Traditionally, population geographers addressed the three components of population change – fertility, mortality, and migration, only. However, contemporary population geography is more thematic and theoretically sophisticated. Various recent contributions to population geography are reviewed and serve as exemplars of the themes of study. Life course studies, intergenerational proximity and mobility, and gendered migration are discussed. By embracing theoretical and future challenges, population geography is poised to make important contributions to our understanding of people and places.

## **Chapter 20 POPULATION, NATURAL RESOURCES AND ENVIRONMENT**

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### **Alan Jowett**

*Centro de Investigación y Docencia Económicas, Mexico*

### ***Contents***

1. Introduction
  2. History of the Debate
  3. Contemporary Approaches
  4. Population and Food Availability
  5. Population and Land Use Cover Change
  6. Population and Water Resources
  7. Population, Energy and Climate Change
  8. Environmental Migration
  9. Final Remarks
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*Summary*

Population-environment studies have implicitly permeated demography but only until the mid-20<sup>th</sup> century has the debate been rekindled and research expanded. This article reviews the origins and history of the population-environment debate and attempts to provide insight into the most recent approaches and methodology. Beginning with the most traditional relationships established between demographic and environmental dynamics, some of the most relevant relations and findings are presented and discussed. This state-of-the-art revision is organized by some dimensions of these dynamics, and is by no means exhaustive. The relationships between population and food availability, land use, water resources, energy and climate change are some of the most visible and studied within this emerging field of study. Some final methodological remarks and suggestions for future research are outlined.

## **Chapter 21 POPULATION POLICY**

**Paul Demeny**

*Population Council, New York, USA*

### ***Contents***

1. Introduction
  2. Population Control in Traditional Societies
  3. Rationale for Population Policy
  4. Population Policy in the Liberal State
  5. Population Policy between the World Wars
  6. International Population Policy after World War II
  7. Population Policy in Response to Below-replacement Fertility
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### ***Summary***

Population policies reflect the concern of human communities with the size and composition of their membership. The communities in question range from small tribal groups in traditional societies to today's modern politically integrated nation states and, beyond that, to the international community concerned with global population trends. This chapter provides a brief summary of policies practiced prior to the 20th century but its main focus is on contemporary national policies expressing countries' efforts to affect population growth as it may hinder or enhance the perceived welfare of their societies, and on international efforts to coordinate and influence population trends globally. Population growth is also affected by mortality and, in a national framework, by international migration; policies dealing with these issues are treated in other chapters. On the crucial matter of fertility behavior discussed in this chapter, its trends are seen to be primarily reflecting individuals' self-interest in their own well-being and in their perception of their children's interest, both powerfully conditioned by the level of economic and social development and by the institutional arrangements prevailing in each society. In many countries, the main thrust of programmatic action when population growth is considered excessively rapid, has taken the form of family planning programs that seek to facilitate access to modern methods of birth control. When developmental and institutional conditions, especially those affecting the status of women, are favorable, such programs, in some cases accompanied by strong administrative pressures, appear to have accelerated the decline of fertility toward replacement levels or in some cases even below such levels. Concern with rapid population aging and eventual population decline caused by such low fertility in some instances has elicited population policies seeking to stimulate birth rates. Such pronatalist policies thus far have proven at best moderately effective.

## **Chapter 22 POPULATION PROJECTIONS AND WORLD POPULATION TRENDS**

**Hania Zlotnik**

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### ***Contents***

1. Introduction
2. The United Nations Population Projections: History and Relevance
3. Methods and Assumptions used to project National Populations
4. Past and Future Population Trends
5. Conclusion

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### ***Summary***

The Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat has been producing population projections for the world and the countries that constitute it since the 1950s. This chapter focuses on the work of the Population Division in producing estimates and projections of the world population and on the implications of such work for our understanding of the relevance of population dynamics for development. It presents a history of the population projections prepared by the United Nations and the rationale for the assumptions that underpin them. It discusses the methodology used to project fertility, mortality and international migration in the most recent set of projections (the *2006 Revision*). On the basis of the results of the *2006 Revision*, this chapter discusses population trends and prospects until 2050 in terms of the expected changes in fertility and mortality; the resulting changes in population growth and size, and trends in population ageing. The focus is on trends and prospects at the world level, the major development groups and the major areas of the world.