The Sociology of Longevity

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Socioecological Factors of Survival Probability

By

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Cambridge Scholars Publishing

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This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-8062-8
ISBN (13): 978-1-5275-8062-6

I want to express gratitude to my son, who is living in the United Kingdom, and with whose assistance, this book was made possible.

TABLE OF CONTENTS

Part 4: Application of SEFs as determinants for becoming a centenarian

Part 5: A society wherein people live to be centenarians

PREFACE

This book documents factors that determine humanity's survival probability of becoming a centenarian (SPBC) as well as the life expectancy (LE) associated with socioecological factors (SEFs).

The data are taken from the Human Mortality Database (HMD), the World Bank and WHO Database, and interviews with centenarians. In particular, SPBC is calculated from the HMD. SEFs and LE are analyzed from the WHO and World Bank Database. In addition, data were collected through interviews with 130 centenarians aged 100 to 108.

The chapters in this book contribute to possibilities for increasing SPBC and LE by applying SEFs analytical strategies to understand trends and patterns in SPBC. The book also includes detailed accounts of 14 factors that affect SPBC and LE.

The book reports on the causes and impact of SEFs on SPBC and LE. A critical finding, confirmed in the analysis of interviews with centenarians, is that SEFs influence LE and SPBC.

As the first time the influence of SEFs on SPBC has been analyzed and described, this book presents evidence of SPBC and LE factors in all countries and contributes to globally applicable knowledge of how to become a healthy centenarian for individuals and country-local societies.

ACKNOWLEDGMENTS

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2017S1A5 B1020830).

LIST OF ABBREVIATIONS

BSS: Basic sanitation services
CLSS: Country-local society support
DCI: Depth of credit information
FDA: Female dominant authority
FSE: Female secondary education
FSP: Female survival probability
FTMPS: Fixed telephone and mobile phone subscribers
GI: Gini index
GEI: Gender equality index
GHE: Government health expenditure
GII: Gender inequality index
GNI: Gross national income
HEPGDP: Health expenditure as a percentage of the GDP
HLE: Healthy life expectancy
ILE: Inequality in life expectancy
IUI: Individuals using the Internet
LE: Life expectancy
MDA: Male dominant authority
MSE: Male secondary education
MSP: Male survival probability
OLE: Old age life expectancy
OPR: Old age pension recipient
OPW: Output per worker
PHL: Personal hygiene-oriented leadership
PLI: Personal life improvement
PSL: Public sanitation-oriented leadership
RLE: Remaining years of life expectancy
SE: Secondary education
SEFs: Socioecological factors
SMDW: Safely managed drinking water
SPBC: Survival probability of becoming a centenarian
SVPW: Services value-added per worker
UP: Urban population

PART 1

APPROACH TO THE SURVIVAL PROBABILITY OF BECOMING A CENTENARIAN (SPBC)

Part 1 introduces the concept of the survival probability of becoming a centenarian (SPBC) and socioecological factors (SEFs), including country-local society support (CLSS). By explaining the correlation between SEFs and SPBC, I emphasize the impact of CLSS on SPBC. In addition, the relationships between CLSS and SPBC and between CLSS and life expectancy (LE) are demonstrated using survival probability graphs. Finally, the lifespan graphs of SPBC and LE (based on increasing/decreasing SEFs) are presented.

CHAPTER 1

THE CONCEPT OF THE SURVIVAL PROBABILITY OF BECOMING A CENTENARIAN (SPBC)

Can we live to be 100 years of age? Is it feasible? If so, how many people can survive to age 100? Is there any way for all humans to live to this age? This book attempts to use a socioecological perspective to answer these questions.

In addition, this book explains the relationship between SPBC, an indicator of the healthy survival of citizens of each country until the age of 100, and the SEFs that affect countries around the globe. Furthermore, the socioecological factors related to LE are discussed, and the research work that identifies them is presented. Based on the results of this study, we propose making efforts toward building a country wherein individuals can live to be 100 years of age. Moreover, if the government utilizes and applies the contents of this book, it is possible that humanity can reach this milestone.

1-1 The concept of SPBC and country-local society support

We hope to live healthily to 100 years or more. The longevity of humans has been affected by various factors. These longevity factors involve both a microscopic and a macroscopic perspective. Microfactors are innate, natural elements. However, macrofactors are influenced by social circumstances. In this regard, we need to consider the sociological perspective for the longevity of humanity. In particular, this book intends to examine the factors of human longevity from a socioecological perspective.

A society of longevity refers to a community where human beings live healthily beyond 100 years. These 100-year-old people are called centenarians. By observing the lifestyle and social environment of centenarians, we can find the root of longevity in the socioecological

aspects. Therefore, the sociology of longevity is a social science that studies societies wherein human beings can live healthily beyond 100 years. We aim to contribute to the healthy longevity of humanity by observing socioecological factors (SEFs) that heighten the survival probability of becoming centenarians (SPBC) for all people.

There are both inherent and acquired factors that affect human life. For instance, genetic factors are intrinsic, and if they are constant, the level of acquired characteristics can affect human lifespan. Furthermore, acquired factors primarily consist of lifestyle habits and national and community factors. Therefore, if these factors affect SPBC, it is necessary to recognize them as an essential issue and conduct a systematic study.

The concept of SPBC introduced in this book is crucial for identifying SEFs and establishing a national strategy for helping people reach the milestone of 100 years old. Specifically, SPBC refers to the number of survivors who turn 100 on a given date, divided by the corresponding cohort size of the specified year (Kim & Kim, 2014a, 2015, 2017a).

For instance, suppose we estimate that individuals who are 70 years old in 1980 will reach 100 in 2010. In that case, the calculation is the number of centenarians in 2010 divided by the corresponding cohort size of 70-year-olds in 1980. SPBC also includes the advantage of controlling for other potential confounding factors (e.g., infant mortality) that affect the centenarian population and overcoming the migration problem inherent in the change of nationality.

Health is influenced by several dimensions from a socioecological perspective, including individual, community, and public policy factors (Kim & Kim, 2017). This book focuses on (1) individual perspectives, (2) community-related perspectives, and (3) public policy perspectives on health promotion. However, it broadly uses the socioecological model from (1) personal life improvement (PLI) and (2) country-local society support (CLSS). Therefore, the socioecological perspective has broadly been classified into the PLI and CLSS domains. The socioecological structure organized in this way may include the following factors (Kim, 2013, 2014b, c, Kim & Kim, 2014a, 2015, 2016, 2017a, b, 2018, 2019).

(1) PLI includes factors such as income, secondary education level, safe drinking water, personal hygiene, mental stress by gender discrimination, personal favorite phone, and Internet use. (2) CLSS includes factors such as the urbanization rate of the population, labor productivity, and the share

of health costs in GDP. In addition, major factors, such as the income inequality phenomenon, ratio of pensioners to population, government medical expenditure, and national credit index, can be classified as CLSS factors. From this point of view, in this book, SEFs had been set up with PLI and CLSS.

First, Point C in Fig. 1.1 shows the following. Until the age of 65, individuals receive good healthcare protection, including the following:

- Vaccinations and nutrition from their parents since infancy
- Programs aimed at ensuring that young adults reach adulthood without suffering from severe illness
- Physical activity and exercise promotion after marriage

Individuals reach the age of 75 without illness by exercising, not smoking, and consuming limited alcohol. In other words, up to the age of 75, an individual can live a healthy life without being too affected by the local community or national health policy. However, individuals beyond this age are inevitably affected by CLSS. In this regard, support and social structure changes can influence an individual's lifespan and survival probability.

As Fig. 1.1 illustrates, survival probability is affected by SEFs such as unique social living environments and eating habits, national health policies, and social structural change. Curve A shows survival probability beyond age 75 among all age groups. After birth, the younger generation maintains a horizontal curve. However, the survival probability after age 75 rapidly decreases due to CLSS and social change. As shown in Curve B, individuals generally maintain their health through personal eating habits and healthy lifestyles until around 75.

However, the survival probability after this age can significantly increase or decrease based on CLSS. Thus, there is a difference between Curves A and B. Specifically, the size of the survival probability scale is determined by CLSS and the rate of personal life change. In addition, the degree of personal–society and CLSS changes (quantitative and qualitative) indicates the range of the increase or decrease in survival probability of an aging society. As for the SEFs, their influences are as follows.

In Fig. 1.1, Curve A shows the relationship between an individual's health level and longevity. For instance, if an individual dies at the age of 100, their survival probability curve is downward and slopes to the right. However, suppose an individual lives with insufficient water and unsanitary drinking water in a nation with a poor national income and impoverished health sanitation welfare. In that case, personal lifestyle and country-local social factors threaten their survival in both the short and long terms. Therefore, the SEFs of individuals and countries may shorten the survival probability of individuals.

In Fig. 1.1, the CLSS of Curve B shows the implementation of the following SEFs:

· Innovative health and social policies
· Implementation of national health insurance
· Community and national government support life expectancy
· National and local healthcare policies and support
· Innovation of national and community health programs
· The local community provides disease prevention programs
· Investments for creating a healthy society
· An increase in the local government's healthcare expenditure support ratio
· Realization of public interest in health
· Implementation of a gender equality society
· Changes in the social health consciousness structure
· Growth in the population of large cities
· Local hospitals equipped with adequate healthcare systems

Therefore, these SEFs will increase the nation's LE and SPBC; that is, the survival probability curve rises to the right. For instance, the implementation of national health insurance can reduce the burden of national medical expenses. In addition, health promotion projects in the local community can prevent diseases, thereby extending individuals' lifespans.

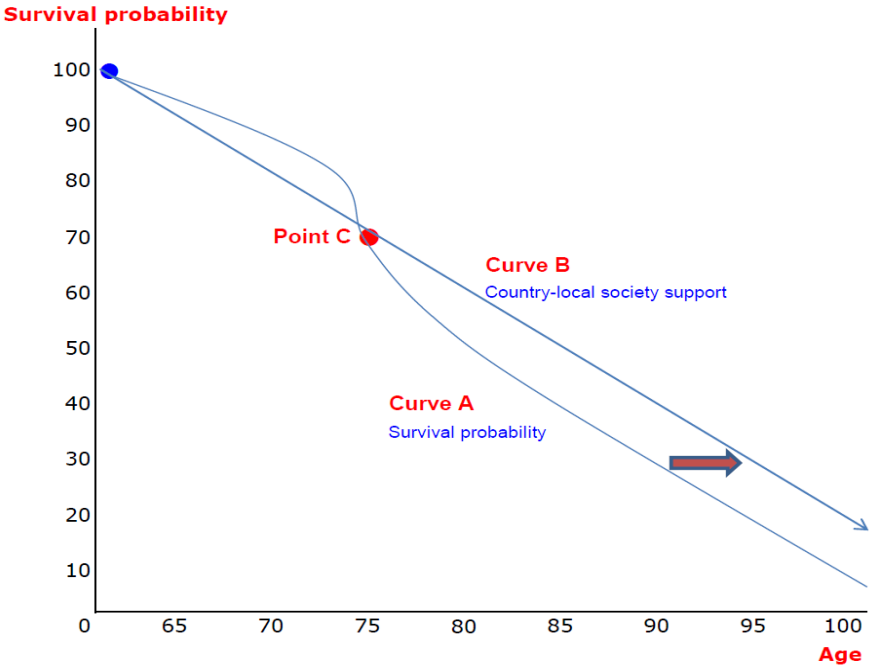

Fig. 1.1. Survival probability and CLSS

1.2 Impact of CLSS

Fig. 1.2 presents CLSS by country, where the Y-axis is the level of survival probability, and the X-axis shows age according to CLSS. For instance, individuals in a country with CLSS 1 have a 50% chance of surviving to age 65, whereas those in CLSS 2 countries have a 50% chance of surviving until 75. Then, in CLSS 3 countries survive up to the age of 100, whereas CLSS 4 countries, 30% survive up to the age of 90.

Fig. 1.2 shows the difference in the survival probability by age in each country based on quantitative and qualitative levels of CLSS. As mentioned earlier, the curve in Fig. 1.1 represents personal health and LE. Accordingly, an individual's survival probability decreases with age. However, in this reality, when a national economy develops, the level of social consciousness changes, and innovative investments are made in the healthcare sector. In addition, an individual's survival probability can vary depending on CLSS. In other words, from CLSS 1 to CLSS 4, the

difference in survival probability by age is based on the aging population and level of CLSS. Therefore, because of the country's aging, the survival probability will create a gap in the national economic status and the ratio of healthcare expenditure to total expenditure.

In addition, as shown in Fig. 1.2, CLSS 3 countries have the highest proportion of survival rates until the age of 100. Compared with other countries, the survival probability until age 65 is similar. However, one can infer an aging society, such as those in CLSS 3 countries, to be a country with a well-established national welfare system for the elderly. In other words, it can be considered to have a national social welfare system that provides effective support, including (1) retirement pensions, (2) specialized hospitals and nursing facilities for the elderly, (3) adequate sanitary facilities, and (4) safe drinking water, all of which are the bases of good health for the elderly. Moreover, suppose a country includes effective medical systems that can transport patients to a general hospital within 30 minutes in an emergency. In that case, the survival probability will inevitably be higher.

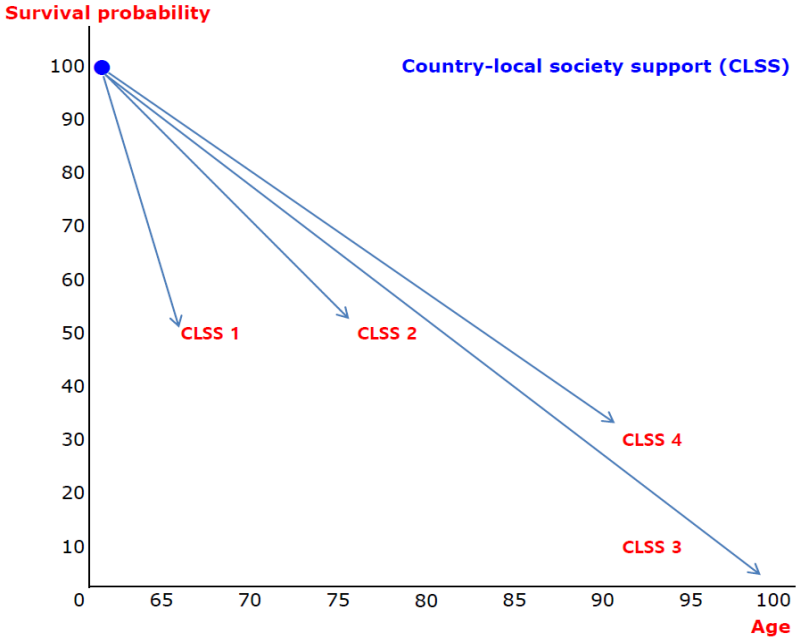

Fig. 1.2. Survival probability and CLSS

Meanwhile, in Fig. 1.3, the Y-axis is LE, whereas the X-axis is SEFs. For instance, in CLSS 1 countries, the CLSS 1 is approximately 50% of the SEFs, with an LE around 60 years of age. However, advanced CLSS 3 countries have an LE of 87 years of age, with 85% of the SEFs used as a national social support system that invests in the healthcare sector. Therefore, CLSS 1 and CLSS 3 countries have a gap in LE because of conflicting national social support systems and changes in social structure.

Fig. 1.3 also explains the close correlation between LE and CLSS. In other words, it assumes that the higher the CLSS, the higher the LE. In addition, from CLSS 1 to CLSS 4, we can hypothesize that the difference in LE occurs according to the SEFs in the countries. For instance, the higher the share of healthcare expenses in government spending, the more significant the difference in LE. This figure shows that CLSS 2 countries include a structure that can predict LE to around 75, based on a healthcare expenditure input of 60%. However, CLSS 3 countries have a national structural system that can predict LE to around the age of 88, based on a healthcare expenditure input of 86%. This indicates that the correlation between the input of SEFs and LE is relatively close.

Due to national economic development and innovative investments in the health sector, LE has been extended from 65 to 70. However, because its input cannot be increased indefinitely, LE cannot be extended similarly. This is because human survival probability and LE include specific limitations. For instance, according to recent data, the lowest LE of any country is 53 years of age, whereas the highest of any country is 85 (an average of 73). Therefore, reducing the differences between these countries is necessary to extend the LE beyond 73 years.

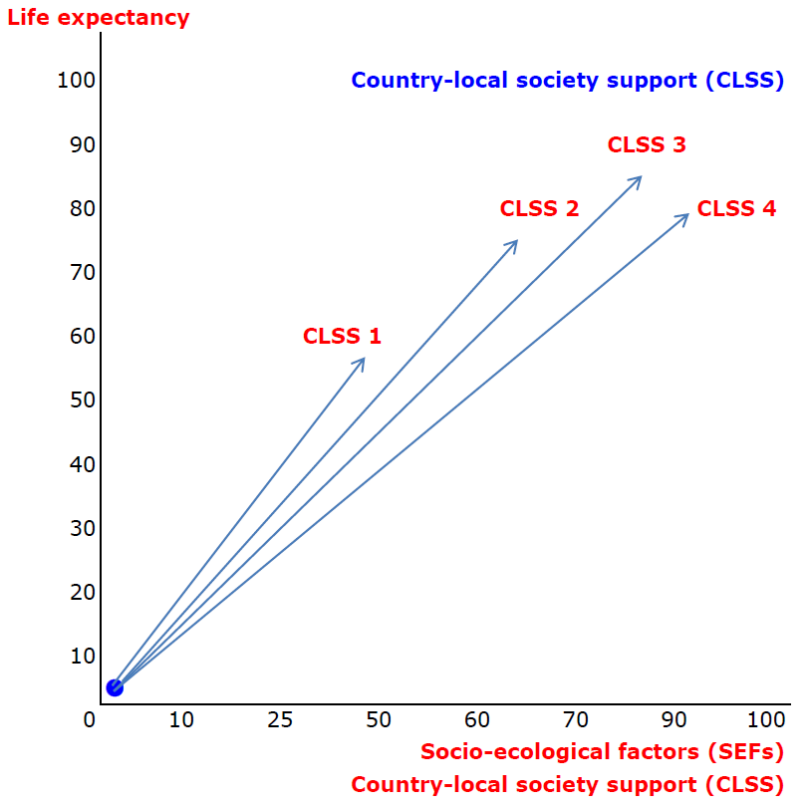

Fig. 1.3. LE and CLSS

Fig. 1.4 shows the quantitative levels and LE of the SEFs, which is an opposing graph to Fig. 1.3. In other words, the SEFs indicate a negative (−) direction. Hence, LE is higher because the value of the SEFs is relatively minor. Alternatively, it suggests that the higher their value, the lower the LE. For instance, if the gender discrimination index is high, the LE will inevitably be low because the socio-structural change is undesirable. Therefore, as for the value of life expectancy, the larger the SEFs that are socially and structurally undesirable, the lower the LE.

It is noteworthy that even if an individual is born with a genetically healthy constitution, they (from the age of 65) may develop diseases due to inadequate healthcare. However, the case of reaching the age of 75 in

good health is similar to what is shown in Fig. 1.1. Therefore, realistically, if a national government intensively allocates medical resources to the healthcare sector, the impact can be enormous. In other words, the influence of an individual's healthy lifespan extension will increase their survival probability and LE the most, as shown in CLSS 3 countries. For instance, at 100 years of age, the survival probability will increase from 5% to 10%, whereas LE will also increase from 75 to 80 years. This indicates that healthcare projects carried out by state and local communities are more effective than individual efforts at maintaining health.

Finally, CLSS 3 countries have an advanced state-led health and welfare system that guarantees a prosperous retirement for an aging society. These developed countries can teach lessons to developing countries, which have low survival rates. For instance, they can provide healthcare information by revealing the reasons for such longevity and the SEFs that affect LE and survival probability the most. In addition, humanitarian efforts should support public health and medical projects in developing countries, which will significantly increase survival probability. SEFs can have a decisive effect on an individual's lifespan; we hope that influential variables can reduce the gap between countries.

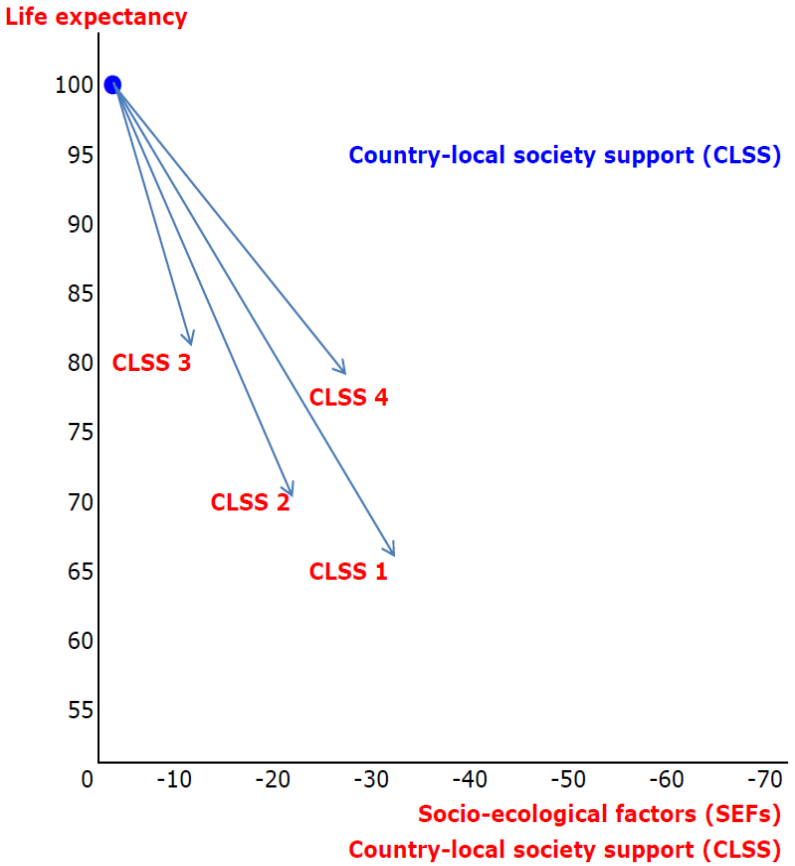

Fig. 1.4. Reverse LE and CLSS

Fig. 1.5 shows the relationship between survival probability and SEFs. In other words, the SEFs indicate a negative (−) direction. Hence, survival probability is higher because the value of the SEFs is relatively minor as in Fig 1.4. Alternatively, it suggests that the higher the (−) value of SEFs, the lower the survival probability. For instance, if the gender discrimination index is high, the survival probability will inevitably be lower because of mental stress. Therefore, as for the value of survival probability, the larger the SEFs that are socially undesirable factors, the lower the survival probability.

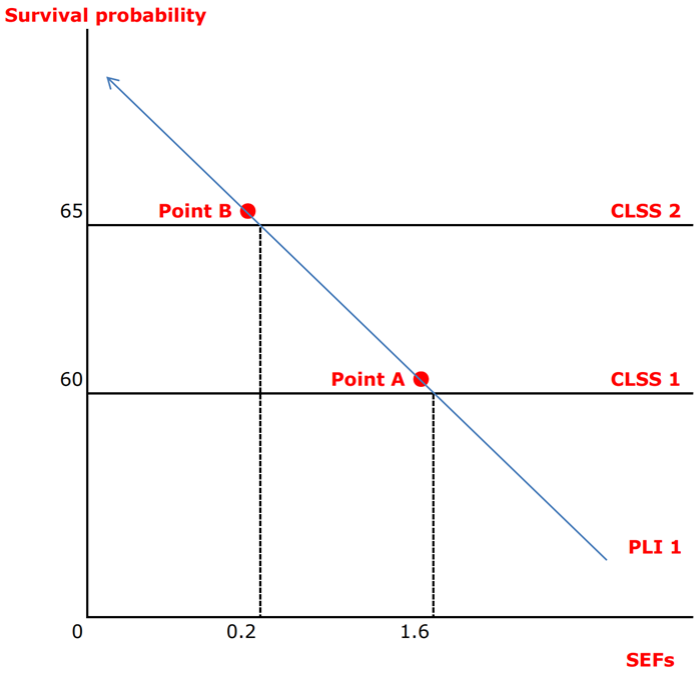

Fig. 1.5. Survival probability and GII of SEFs

If PLI is the gender discrimination index (GII) in Fig.1.5, as the GII factor increases, the GII of SEFs continues to deteriorate, and the survival probability decreases. In terms of CLSS, the survival probability is 60 years old when the sex discrimination index is 1.6 in a CLSS 1 country, with a very high sex discrimination index in the current national society (point B). However, in a CLSS 2 country, the gender discrimination index is 0.2, and the probability of survival is 65 (point A). Thus, the difference in survival probabilities between these countries is a 5-year gap.

However, in Fig.1.6, PLI is upward sloping. Because if the PLI in this case is basic sanitation services (BSS), the survival probability increases as BSS increases. In Fig.1.6, in a CLSS 1 country with a very low BSS in the current national society, when BSS is 80%, the survival probability is 75 years old (point B). However, in a CLSS 2 country, when the BSS is 90%, the survival probability is 80 years old (point A). Therefore, the difference in survival probabilities between these countries is a 5-year gap.

Thus, an increase or decrease in GII and BSS of SEFs leads to an increase or decrease in the survival probability of humanity. This book will empirically explain these outcomes using various studies in each chapter.

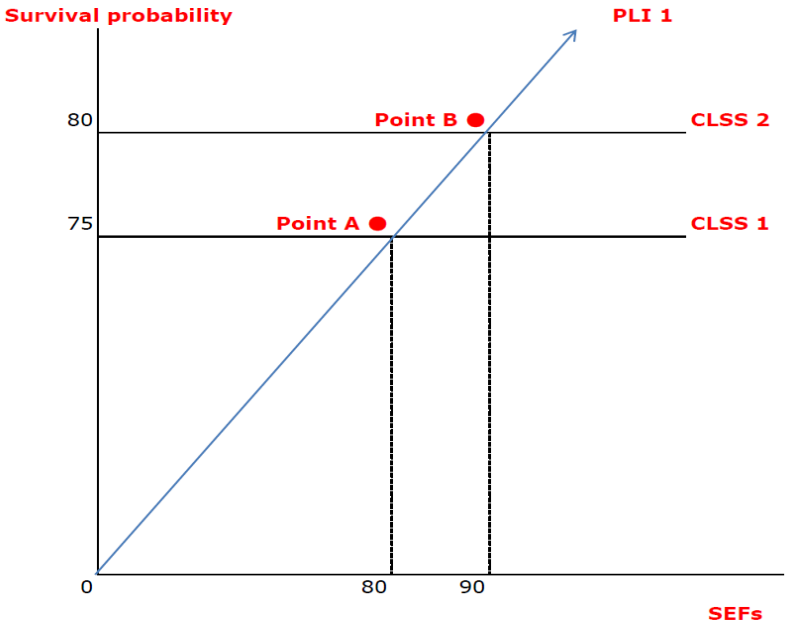

Fig. 1.6. Survival probability and BSS of SEFs

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PART 2

FACTORS FOR BECOMING A CENTENARIAN

Part 2 presents the conceptual graphs of survival probability and examines the correlations between SPBC and PLI and CLSS in SEFs. Further, it focuses on the SPBC at 82 years of age and explains significant SEFs.

CHAPTER 2

THE SOCIOECOLOGICAL FACTORS (SEFS) OF BECOMING A CENTENARIAN

Chapter 2 introduces the SEFs that determine SPBC. As explained in Part 1, SPBC is affected by SEFs' increase and decrease through CLSS and PLI. Thus, this chapter shows the synergistic effect on SPBC when CLSS and PLI are combined. However, there is a gap in SPBC, depending on the increase/decrease in these two aspects. In this case, nine variables of PLI and CLSS are used to express the influences of SEFs in 39 countries. Moreover, the association between SPBC and these variables is described using data from the 'Human Mortality Database.'

2.1 Increase in survival probability and life expectancy (LE)

2.1.1 Personal life improvement (PLI)

The factors that determine an individual's survival probability can initially be found in their diet and lifestyle (i.e., food, clothing, hygiene, and shelter). Fig. 2.1 presents a curve regarding the association between SPBC and PLI. For example, the 85-year-old PLI 1 curve shifts to the 90-year-old PLI 2 curve, thus extending the lifespan. As a result, the 90-year-old's survival probability improves by 20%, from 10% to 30% (Fig. 2.1). This is due to the formation of triangle ABC, which indicates that the survival probability can increase by improving an individual's income, hygiene, living environment, lifestyle, diet, and stress levels. Specifically, the survival probability increases by 20% by vertically moving from Point A to Point C and extending from 85 to 90 years by horizontally moving from Point B to Point C. In addition, this chapter empirically discusses a case in which a 70-year-old can become 100 years of age based on improved income and living environment.