# Active Aging: A Global Goal
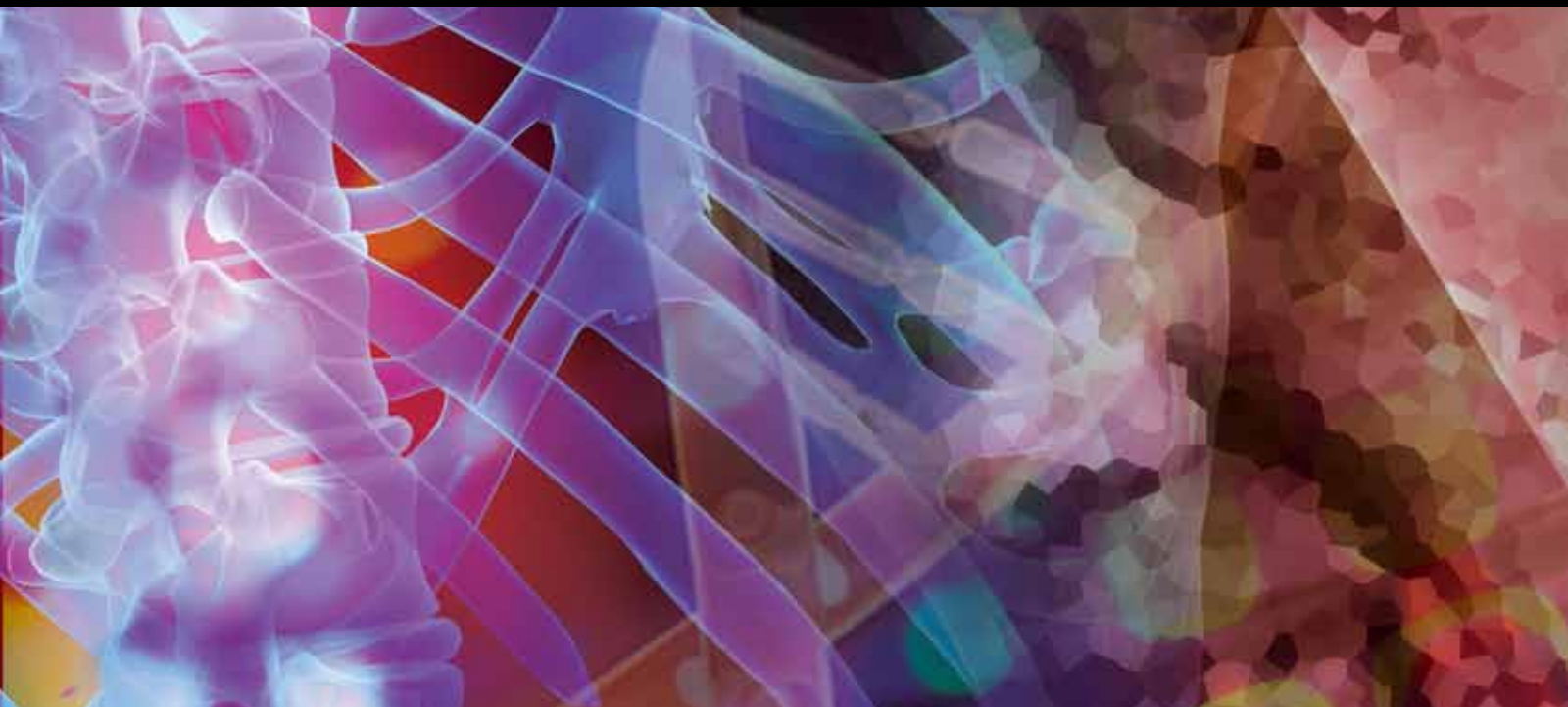
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# Editorial Board

# Contents

## *Editorial*
# Active Aging: A Global Goal

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Throughout the world, populations are growing older; although in developed countries population Aging started early in the XX century [1], less developed countries begun more recently. Therefore, it can be stated that population Aging is a global phenomenon. Population Aging must be considered as a success of the human race since it is the product of a long adaptation process, that is, we are coincident with that the increase in life expectancy has been determined by the development of lifelong education, biomedical advancements, socioeconomic progress, and the democratic political extension of these social developments, which in some countries has doubled life expectancy in under a century.

Nevertheless, since individual Aging is associated with illness and functional loss, and disability-free life expectancy (DFLE) is significantly lower than life expectancy at birth (LE), this global demographic transformation, sometimes called "the silent revolution," is considered by many as a threat in terms of public health and economic costs. But, life expectancy with disability (LEwD) shows a very broad variability among the world: while in some countries an individual born in 2002 can expect to have 10 years in poor health, in others countries this expectation is reduced to less than 7 years. Differences both in LE and in LEwD are expressing the extent to which there are inequalities in environmental conditions which, to a large extent, account for the variability in the ways populations are Aging.

From a population perspective, the new paradigm of successful Aging, or Aging well, started in the eighties based on the compression of morbidity as a key concept for the development of this new paradigm in contrast with the common understanding that longevity necessarily increases morbidity [2, 3], or produced a dynamic equilibrium ([4], for a review see [5]). Latterly, authors noted how, since the 1950s, in selected countries, mortality after the age of 80 years has steadily fallen, they showed evidence that human senescence has been delayed by a decade strongly associated (from 1850) with behavioral and healthy "best practices" [6, 7].

Aging is not only a population phenomenon but also an individual reality and experience. Biogerontologists stated that while a 25% of the ways individuals age are accounted by genetics, it can be estimated that 75% are due to environmental conditions, including those behavioral events who select external conditions [8]. Therefore, at individual level, Aging is a long process across the individual life span governed not only by age and genes but by the interactions between socioenvironmental conditions with personal and behavioral events [9, 10]. Thus, at the individual level, Aging is not an at random phenomenon: the individual is an agent of his/her own Aging process, and the capacity for Aging well-healthy and active-comes, in a certain extent, from decisions taken by individuals themselves as well as his or her behavioral repertoires learnt across the life span.

From an evidence-based point of view, it has been during the last decades of the XX century, with, the so-called "new paradigm" in the field of research on Aging and in a broad sense in the science of gerontology: a positive view (for a review see [11]). Pioneers in this new paradigm are authors from several gerontological disciplines, that is, from the fields of biomedicine and social sciences such as Fries and Crapo

[3], Fries [12], Rowe and Kahn [13], or Baltes and Baltes [14]. This positive view of Aging adopted several verbal rubrics: "healthy" [15], "successful" [13, 14], "optimal" [16], "vital" [17], "productive" [18], "active" [19, 20], "positive" [21] or, simply, "aging well" [12] or "good life" [22]. It is important to emphasize that all these terms are taken by several authors interchangeably when they review the field (e.g., [23–25]); others try to establish differences between healthy Aging, active or successful Aging, and productive Aging [26, 27].

The worldwide phenomenon of active Aging also brought an acknowledgement by the United Nations (UN) of the many challenges regarding Aging and national development, issues concerning the sustainability of families and the ability of states and communities to provide for Aging population, that is, active Aging is placed as key concept. In April 2002, representatives from 159 nations met in Madrid to convene the *Second UN World Assembly on Aging*, two decades after the first assembly celebrated in Vienna in 1992. Although during the last three decades cross-sectional, longitudinal, and intervention studies on "Aging well" have been published, active Aging has been defined for the first time in 2002, by the WHO, in the booklet "*Active Aging. A policy framework*" as "the process of optimizing opportunities for health, participation and security, in order to enhance quality of life and wellbeing as people age." The concept active Aging was adopted by *the United Nation Madrid II International Plan of Action on Aging*. Moreover, active Aging inspired policies at national, regional, and international actions among them the last one has been head by the European Union which declared *2012* the *European Year of Active Aging and Intergenerational Solidarity*. In sum, active Aging can be considered as *a global goal and as a political concept* [28] and it has even been converted into a *mantra* in Aging societies.

From a scientific perspective, *active Aging* can be considered as an umbrella concept embracing a semantic space in which healthy, successful, or productive Aging are strongly related. All these terms are considered as multidimensional and multilevel concepts and all of them are referring to a positive way of Aging or "Aging well," and, as mentioned above, opening a new paradigm in gerontology, based on the delay of senescence, the compression of morbidity and mortality, the diversity of the ways of Aging, and the plasticity of human nature in front of enrichment circumstances [11, 27, 29].

Although there is not an empirical definition of active Aging commonly accepted, there is a certain consensus that it embraces a set of domains: low probability of illness and disability, high physical fitness, high cognitive functioning, positive mood and coping with stress, and being engaged with life (see [11, 13]). Those expert definitions are coincident with what lay older adults consider; thus, more than two-thirds of lay people from several countries and several continents understand active Aging as a set of personal ingredients such as "remaining in good health," "feeling satisfied with life," "having family members and friends who are there," "adapting to changes related to Aging," and "taking care of oneself" [30].

It must be emphasized that since there is not a commonly accepted definition of active Aging, studies looking for

prevalence show a very confused panorama. From the cross-sectional and longitudinal studies of healthy or successful Aging reviewed by Peel et al. [25], results yielded a broad range of successful agers: from 12.7% ("survival, high level of functioning") to 49% ("old age having little or no disability prior to death) and Depp and Jeste's [23] review yielded an even broader range of prevalence ranging from 0.2 to 97%. Fernández-Ballesteros and her group [31] through very broad differences between "simple" (93% "absence of support needed" to 27.4% "no illness reported" and "combined" outcomes (from 27,4% through 15.5%) and also between subjective (e.g., 80% "life satisfaction" through "MMSE" score higher than 28, 47%). The most accepted conclusion to these and other results is that a commonly accepted operational definition of active Aging is requested.

Researchers distinguish between active Aging as an outcome of a lifelong process to its determinants or predictors. Thus, at the population level WHO posited 6 main determinants of active Aging: behavioral styles, personal biological and psychological conditions, health and social services, physical environment, and social and economic factors. Research searching for determinants of active Aging distinguish long-term determinants such as education, socioeconomic status, profession, life styles, health status, personality factors, or cognitive aptitudes [31]. During the last decades several experimental studies have been published with very promising evaluation studies and results from multidomain active Aging promotion programs (e.g., Active Aging South Australia), or programs promoting specific domains of active Aging such as physical activity (e.g., California Active Aging project), promotion of cognitive fitness (e.g., ACTIVE program), social participation, and others. Much more evaluation research must be conducted in order to tests active Aging good practices, training, projects, or programs.

In spite of the fact that there are a theoretical corpus of knowledge, empirical cross-sectional and longitudinal, experimental research on active Aging, and social plans and policies for promoting active Aging, much more research results, debates, and discussions are required in order to make a step forward in this field. That is the main goal of this special issue on the 2012 European Year of Active Aging and Intergenerational Solidarity.

Ten papers are published in this special issue, by authors from around the world, contributing to some of the problematic issues we outline in our editorial and some of them enlighten with cross-cultural results on active Aging coming from several countries and regions.

Regarding theoretical models of active Aging, C. Paúl et al. try to validate the population WHO 6 determinants factors of active Aging in a sample of Portuguese community-dwelling older adults in their contribution entitled "*Active Aging: an empirical approach to the WHO model.*" Performing a factorial equation modeling, they do not confirm the original model, but they arrived at a six-factor model where individual factors are explaining a 54% of the variance: health, psychological factors, cognitive performance, social relationships, biobehavioral components and personality. Much more research testing the WHO model (both outcome

definition and posited determinants) from a multilevel population perspective is required.

In "*The theory and practice of active Aging*" J. F. Fries returns to the dynamic interaction of morbidity and mortality trends, the subject of his pioneering research more than three decades ago, and specifically to the erroneous assumption that morbidity would continue to develop at a specific age while mortality could be postponed continuously. Analyses of data from two controlled longitudinal studies of Aging, supported by the wider literature, suggest that exercise improves health in terms of both mortality and cumulative lifetime disability. Most importantly, this paper demonstrates that the absence of risk factors, such as lack of exercise, smoking, and overnormal body weight, is associated with a postponement of disability that significantly exceeds the postponement of mortality (6.7–9 years) and, therefore, a compression of morbidity closer to the age of death.

Exploring the prevalence of active Aging based on Rowe and Kahn's model in a community dwelling sample of Western Mexico assessed through the SABE Protocol (which is being administered through Latin American countries by PAHO), E. D. Arias-Merino et al. are reporting their results in the paper "*Prevalence of successful aging in the elderly in Western Mexico*." An average of 12.6% older adults were considered "aging well." As in others studies, significant differences were found by age (lower percentage in those older), gender (women), education (lower education), and marital status (single).

In the paper "*Social determinants of active aging: differences in mortality and the loss of healthy life between different income levels among older Japanese in the AGES cohort study*" H. Hirai et al. explore the relationship between income and loss of healthy years in a large sample of persons aged 65 or older in Japan. Within the Aichi Gerontological Evaluation Study (AGES), functionally independent elderly people have been followed during four years. The authors found that people with lower incomes were not only more likely to die than those with higher incomes but also more likely to report loss of healthy life years. This paper underlines the significant roles of social factors and social inequalities even in a rather egalitarian country.

Another important contribution to this special issue comes from the very informative description of the CIS (former Soviet Union) countries made by A. Sidorenko and A. Zaidi from the European Center for Welfare Policy and Research (Vienna) in the paper "*Active Aging in CIS countries: semantics, challenges and responses*." This highlights a region not very well known from an Aging and active Aging point of view. Coming from a period of financial instability and immersed in a accelerated processes of Aging, it is highly promising to learn that political actions, such as the 2012 European Year of Active Aging, are promoting health and independent living of older adults.

From the Institute of Gerontology (University of Heidelberg, Germany), A. Kruse and E. Schmitt contribute to this special issue with the paper "*Generativity as a route to active Aging*." After discussing the importance of active Aging from an individual as well as from a societal perspective as human capital, they focus on the psychological construct of generativity, reporting results from Mexico and Baltic countries and their cooperative research under the Dialogue Forum Project Funding, yielding interesting improvements of generativity in Belarus, Russia, and Ukraine by implementing and supporting local initiatives offering opportunities for intergenerational dialogue and complementing the results from A. Sidorenko and A. Zaidi and E. D. Arias-Merino et al.

A theoretical article deals with a dynamic system model, the Janus model of development, "*On the dynamics of active aging*" by J. J. F. Schroots (Free University of Amsterdam, The Netherlands). The author provides very powerful theoretical and methodological tools for understanding the nature of development, based on the simplest possible set of underlying principles: the unitary lifespan trajectory with two complementary forces, growth and senescence, the peak capacity and peak time refer, respectively, to the impact of growth rate (peak capacity) and rate of senescence (peak time). Perhaps, most importantly, the validity of those principles is supported by simulating the empirical lifespan trajectories of functional capacity, intelligence, and mortality.

In their investigation of "*Mobility and active Aging in suburban environments: findings from in-depth interviews and person-based GPS tracking*," E. Zeitler et al. use person-based GPS tracking to explore how suburban environments have an impact on older people's mobility and their use of different forms of transport. They found that suburban environments can create barriers to mobility which restrict the potential for activity in later life. Inaccessible public transport has the effect of increasing car dependence among older people.

"*The right to move: a multidisciplinary lifespan conceptual framework*" is a serious call by the Health across Life Span work group of the University of Michigan's Society directed by T. C. Antonucci et al. proposing a proactive model to combat increasing inactivity associated with increasing obesity. This paper compliments that of J. F. Fries and details the benefits of physical activity from cells to culture through five intermediary organizing levels, such as family, community, and corporation. According to the authors, physical exercise is a powerful and low-cost solution to improve cognitive, emotional, and physical health and well-being. This paper demonstrates how and why all stakeholders have an interest in participating or contributing to such a move.

The paper "*Active aging promotion: results from the Vital Aging program*" by M. Caprara et al. (from several Spanish and Latin American Universities) describes a program promoting active Aging at the individual level. "Vital Aging" has been developed and tested in Spain as well as in several Latin American countries. The program targets individual determinants of active Aging, such as physical exercise, balanced nutrition, cognitively challenging activities, positive affect, and sense of mastery. The paper presents four evaluation studies corresponding to different formats of the proposed program, including e-formats. Limitations and futures steps are discussed. A large part of the paper is devoted to clarify the terminology used when aging is considered from a positive perspective. Thus, the authors describe a semantic network of aging well, including active, healthy, successful, productive, competent, vital, or optimal aging.

Our gratitude is to all authors for their outstanding contributions.

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*Alex Kalache*

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*Review Article*

# Active Aging Promotion: Results from the *Vital Aging* Program

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Active aging is one of the terms in the semantic network of aging well, together with others such as successful, productive, competent aging. All allude to the new paradigm in gerontology, whereby aging is considered from a positive perspective. Most authors in the field agree active aging is a multidimensional concept, embracing health, physical and cognitive fitness, positive affect and control, social relationships and engagement. This paper describes *Vital Aging*, an individual active aging promotion program implemented through three modalities: Life, Multimedia, and e-Learning. The program was developed on the basis of extensive evidence about individual determinants of active aging. The different versions of *Vital Aging* are described, and four evaluation studies (both formative and summative) are reported. Formative evaluation reflected participants' satisfaction and expected changes; summative evaluations yielded some quite encouraging results using quasi-experimental designs: those who took part in the programs increased their physical exercise, significantly improved their diet, reported better memory, had better emotional balance, and enjoyed more cultural, intellectual, affective, and social activities than they did before the course, thus increasing their social relationships. These results are discussed in the context of the common literature within the field and, also, taking into account the limitations of the evaluations accomplished.

## 1. Introduction

The concept of aging well as a scientific field dates back to the early 1960s, within the context of the World Health Organization (WHO), when Roth highlighted the importance of health promotion and illness prevention throughout the life span, and especially in old age [1]. Most importantly, in the 1980s, one of the pioneers in the field of aging well, Fries, would stress the modifiability and plasticity of the human being throughout life and into old age, listing nonmodifiable negative conditions associated with age and their correspondence with modifiable preventive factors [2–4]. Recently, Christensen, Doblhammer, Rau, and Vaupel noted how, since the 1950s, mortality after age 80 years has steadily fallen, with life expectancy lengthening almost in parallel with best practices over the last 150 years [5] and they showed evidence that human senescence has been delayed by a decade [6] strongly associated with "healthy best practices."

In fact, the aging revolution is the result of falling mortality rates and the corresponding increase in life expectancy. But, these changes in the population are due not only to biomedical advances, but also to the exponential

development of human society across history: compulsory education, economic growth, the extension and democratization of the improvement of life conditions, better healthy practices, extended scientific knowledge, and so forth, have all made their contributions to this revolution. At the same time, we have seen the emergence of the active aging paradigm [7, 8].

In the WHO document *active ageing. A policy framework*, the determinants of active aging posited were mainly population-based: Economic, Social, Environmental, and Health and Social Services, suggesting that the responsibility for active aging lies with the public sector, through public health programs and social policies [9]. The implementation and evaluation of such programs are necessarily long-term, and therefore highly complex. As Christensen et al. show, one way of evaluating "best practice" in health is through the association of such practices with population-based indicators such as mortality, or life expectancy, or even disability-free life expectancy, healthy life expectancy, or quality-adjusted life years [5].

Even so, as stressed elsewhere, not only it is important to promote active aging from a population-based point of view, it is also relevant to do so from an individual perspective. Aging well is not a random phenomenon: the individual is an agent of his/her own aging process, and the capacity for aging actively comes not only from sociopolitical actions, but also through decisions taken by individuals themselves. Thus, among the determinants posited by the WHO, two types of individual-based factors can be found: Behavioral (lifestyles) and Personal (both biogenetic and psychological) [10].

Active aging is a multidisciplinary concept (also called successful, productive, or optimal aging), and cannot simply be reduced to "healthy aging," needing, rather, to take into account protective behavioral determinants (protective life styles and the prevention of risk factors) [10–12]. Moreover, a definition of aging well must include other psychosocial factors, such as cognitive and mental functioning, positive mood, sense of control, active coping styles, and social participation and engagement. Promotion and education in relation to these factors through psychosocial initiatives extending the encouragement of healthy lifestyles (such as physical activity or good nutrition) to other aspects, such as memory training, stress management, self-efficacy coaching, or training in prosocial behavior, would appear to represent a step forward in the promotion of active aging. Supporting literature of those aspects will see shortly listed when our four domains model will be presented.

This paper deals with a set of psychosocial and educational interventions called "*Active Aging*" with various formats (*Life Course, Multimedia*, and e-Learning) for the promotion of active aging at the *individual level*—that is, *without* modifying any of the posited determinants at the population-based level (income, macrosocial and environmental conditions, or health and social services).

Here we consider three programs, all of which have been implemented at the Autonomous University of Madrid (UAM; Spain), and the last one also in other three Latin American Universities: *Vital Aging* life, *Vital Aging* multimedia and *Vital Aging* e-Learning.

## 2. *Vital Aging* Program

Here we provide a brief presentation of the *Vital Aging* Program summarized from other published materials [10, 12–17].

*2.1. Basic Principles.* Underlying the *Vital Aging* is a set of theoretical assumptions.

(1) There are major differences in forms of aging (normal, optimal, and pathological), and there is empirically-based knowledge about how to age well [4, 18].

(2) This diversity across the life course is not random. External circumstances are crucial to the aging process, but the individual is also an agent of his or her own aging process [19].

(3) Plasticity is a property of the Central Nervous System, but also of the human organism. Plasticity, though subject to certain limitations, remains throughout the life span and into old age. Over the course of life, plasticity is expressed through learning and modifiability [7, 20, 21].

(4) Selection, Optimization, and Compensation are adaptive mechanisms found within the aging process; knowledge-based pragmatics, high motivation, and technology can compensate decline [7].

*2.2. A Four-Domain Model for the Vital Aging Program.* Underpinning the content of the *Vital Aging* program is a 4-domain model of aging well posited by Fernández-Ballesteros, [10, 22] whereby active aging is defined as the lifelong adaptation process of maximizing health and independence; physical and cognitive functioning; positive affect and control; and social engagement [10].

As shown in Figure 1, this four-domain model of aging well has recently been tested by Fernández-Ballesteros et al. [23] through Structural Equation Modeling, with data both from our cross-cultural project on lay definitions of aging well provided by older adults from 7 Latin American and 3 European, [24–26] and from the ELEA research project (Longitudinal Study of Active Aging) [27].

As far as the four domains of active aging are concerned, they are not only based on Structural Equation Modeling using empirical data (from lay definitions and research findings), but also strongly supported by the scientific literature. Although, this is not the place to present all such evidence (for a review, see: Fernández-Ballesteros, 2008), [10] let us consider some examples.

*(i) Behavioral Lifestyles.* (1) Regular physical exercise reduces mortality risk by about 35% (e.g., Healthy Aging Longitudinal European study) [28, 29]. (2) Elders with healthy behavioral life styles show *four times less* disability than those who smoke, drink too much, do not exercise, and are obese. Moreover, in those with good behavioral habits the onset of *initial disability was postponed by 7.75 years* [30]. (3) Netz et al. carried out the most recent meta-analysis of those studies linking physical activity to mental health and well-being.
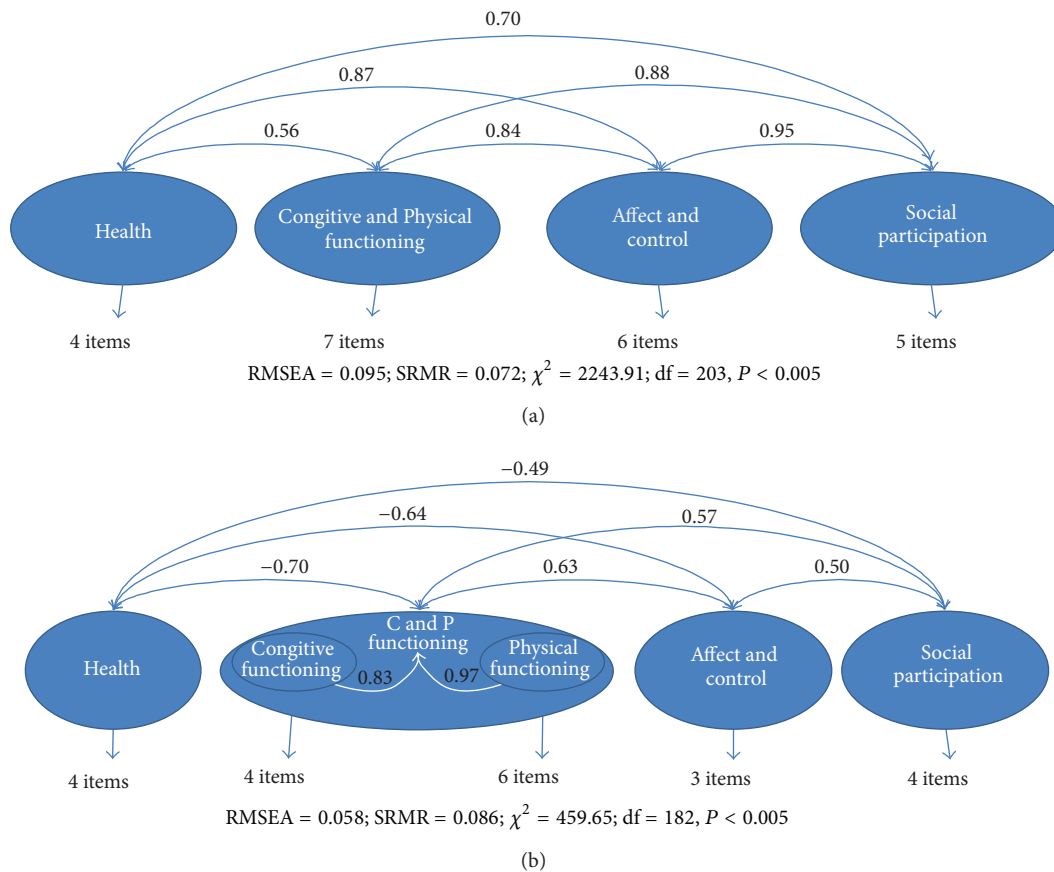
FIGURE 1: Structural Equations Modeling of four-domains model of ageing well: (a) from lay conceptalizations ($N = 1,189$), and (b) from ELEA PROJECT multimethod data base ($N = 458$).

Studies with older adults shows that effect sizes for physical exercising treatment groups were almost 3 times as large as the mean for control groups [31]. (4) Mediterranean diet (low intake of saturated and trans fat and high consumption of fruit and vegetable) is stronger related to survival and life expectancy [32–34]. (5) This type of diet decreases coronary mortality about 40% and all causes of mortality about 20% [35, 36].

*(ii) Cognitive Activity and Training.* (1) More frequent cognitive activity in everyday life is associated with a reduction of approximately 19% in annual rate of cognitive decline, and is also a protective factor against dementia [37, 38]. (2) The effects on cognitive functioning of cognitive training are of a magnitude equivalent to the decline expected in elders without dementia over a period of 7 to 14 years, though longer follow-up study is required [39]. (3) Memory training yields effects sizes of 0.75 SD, by comparison with 0.40 as a practice effect, in both objective memory tests and subjective memory functioning [40, 41]. (4) A meta-analysis carried out by Colcombe and Kramer with 18 intervention studies examining the effects of physical fitness training on cognitive functions yielded robust effects for several measures of cognitive functioning [42]. In sum, all these progresses support not only a more complex view of cognitive functioning across life span but a new panorama in which effective cognitive trainings and intervention can optimize cognitive functioning, compensate intellectual losses and declines or even palliative cognitive impairment (for a review see: Hertzog et al, 2009) [41].

*(iii) Positive Affect, Coping, and Control.* (1) *Positive Affect* reduces mortality in older individuals. The benefits of positive affect can be observed in conditions as diverse as stroke, rehospitalization for coronary problems, the common cold, and accidents; highly activated positive emotions were associated with better functioning of cardiovascular, endocrine, and immune systems [43]. A positive attitude towards life may help us avoid becoming frail. For those reporting positive affect 7 years earlier, the chance of becoming frail fell by 3%, while the chances of having better health outcomes, greater functional independence increased, as did survival rates. The authors conclude from these finding that positive affect is protective against functional and physical decline in old age as well as negative affect such anxiety are requiring coping and management [44]. The most important conclusion emerging from coping and aging literature is that although there is a broad evidence about the stability of coping behaviour across life span, authors distinguish specific positive coping skills in old age which can be trained and promoted [45, 46]. (3) Sense

of Control and Self-efficacy. Older adults with a high sense of control are better off on many indicators of health and well-being and those who have a lower sense of control may be at increased risk for a wide range of negative behavioral, affective, and functional outcomes, including higher levels of depression, anxiety, and stress, use of fewer health protective behaviors (e.g., exercise) and compensatory memory strategies (e.g., internal or external memory aids), and have poorer health and memory functioning. Also, the sense of control is a powerful psychosocial factor that influences well-being and it is a good predictor of healthy and active aging; finally, sense of control can be trained as has been largely tested [47–49]. Among control concepts, self-efficacy is perhaps the best well-known construct in successful ageing literature. In the last twenty five years self-efficacy has been searched through cross-sectional, longitudinal and experimental designs [19]. Self-efficacy beliefs are strongly related with successful aging, firstly because they contribute to perceive age related situations not as threats but as challenges; secondly, because they support to individual to remain committed in selected goals and, finally, because self-efficacy perceptions have a synergic power with other factors for enhancing outcomes [10]. (4) Self-stereotypes or self-images about aging reduce the risk ratio of .87 ($P < .001$). Persons with positive images about aging (assessed 25 years earlier) lived 7.5 years more than those reporting poor self-perception of aging at baseline. One aspect of the positive self-perception of aging measure, risk of dying, fell by 13% [50, 51].

*(iv) Social Functioning and Participation.* (1) The association between social relationships and the prevalence and incidence of and recovery from disability has been well established [52]. (2) Research results have shown a strong and robust cross-sectional association between social engagement and disability, more socially active persons reporting lower levels of disability than their less active counterparts [53]. (3) There is empirical evidence that social activity and participation improve cognitive functioning [54]. (4) Results have shown that the protective effects of social engagement diminish slowly over time [55].

In summary, there is strong support for these four domains of active aging on which the *Vital Aging* Program is based (for a review, see Fernández-Ballesteros, 2008) [10].

### 2.3. Vital Aging Program Versions.

The starting point was the *Vital Aging* course (Vivir con Vitalidad) developed in 1996 at the autonomous university of Madrid (UAM), developed by Fernández-Ballesteros as an open life course. Since 1996, several editions of the *Vital Aging* course have been run; a multimedia version and an e-Learning course have also been developed. Let us now describe these three programs.

*(i) Vital Aging L (1996–2003).* Organized as a continuing education course at the UAM, it consists of 20 thematic units over 70 hours (3 hours per session, 2 sessions per week). Trainers are experts in a variety of subjects, teaching in highly practical way and supported by a basic text (drawn up by Fernández-Ballesteros) [12]. All sessions have a similar structure: (1) the trainer makes a general presentation of the

content in question, talking about the supporting evidence on each unit; (2) a pretest for the particular behavioral or psychological characteristic (diet, physical exercise, self-efficacy, pleasant activities, etc.) is administered; (3) practical strategies for better aging are described and reviewed, and exercises are performed; (4) at the end of the class a post-test is administered, and the results are discussed; (5) finally, the trainer makes some concluding remarks (for a summary, see Table 1).

*(ii) Vital Ageing M.* The *Vital Aging*-L was transformed in to the *Vital Aging* multimedia course developed under the auspices of the European Commission, as a Socrates-Minerva Program, by a Consortium made up of UAM (Spain), Nettuno (Italy) and the University of Heidelberg-Institute of Gerontology (Germany), and with the cooperation of the Open University (UK). *Vital Aging*-M consists of 48 hours of video lessons grouped in 20 Thematic Units with supporting materials on the Internet. Each Unit comprises 2 to 4 hours' video-lessons taught by European experts from Germany, Italy, and Spain (so far the program is available only in Spanish). Although, at the very beginning *Vital-Aging*-M program was broadcasted through the Italian TV-Chanel 2, all our evaluation studies were based on the administration of those video-lessons in the class-room by a trained tutor who is in charge of all equipments, the distribution among participants of the supporting materials, and the assessment instruments for each video-lesson. Participants follow all sessions of each lesson, fill out the instruments, and work with the material distributed present in the video-lesson. Each lesson lasts approximately 2 hours, with a break of 15 minutes between sessions. Lessons have the same structure and content as in *Vital Aging*-L and e-Learning versions (Table 1).

*(iii) Vital Aging e-Learning.* The program was supported by the UAM-Santander Inter-University Cooperation Program for Latin America (2010–2012), with the main goal of developing an e-learning methodology for senior citizens' university programs (PUM-e). In the first step, a pilot format of the program was implemented at UAM and the Catholic University of Chile, and subsequently assessed. Based on this pilot study, *Vital Aging* materials designed to be used on via Internet by Fernández-Ballesteros (http://www.vivirconvitalidad.com/) were adapted cross-culturally with the contribution from the three Latin American universities. Several changes were made to obtain an e-learning format that could be implemented through the Learning management System, LMS-Moodle Platform. Finally, the program was launched at the four participating universities: UAM, Catholic University of Chile, La Habana University (Cuba) and the National Autonomous University of Mexico. The *Vital Aging* e-Learning program requires around 65 hours of work, and was run over a period of three months. Students had a set of learning resources as follows. (1) Self-evaluation: in order to give the student a base-measure of his/her performance in each basic unit, a questionnaire is filled out, the responses being checked automatically. This self-evaluation is useful for making students aware of their status in relation

TABLE 1: Summary of *Vital Aging* versions: procedures for implementation and evaluation.

| | Vital Ageing L | Vital Ageing M | Vital Ageing e-Learning |
|---|---|---|---|
| Date of implementation | 1996–2003 | 2002–2012 | 2012 |
| Duration each edition | 3 months, 70 hours (3 hours/session; 2 sessions per week) | 3 months, 48 hours (2–4 hours per session, 2 sessions per week) | 3 months: 1 unit per 2 week |
| Trainers | Experts | Experts from Germany, Italy, and Spain<br>Organized by a Tutor | Organized by a Virtual Tutor and an On-site tutor |
| Materials | Basic Text: Fernández-Ballesteros [11]<br>Standard classes | Multimedia learning technology<br>Video Lessons | Basic texts: http://www.vivirconvitalidad.com/<br>Learning management System, LMS-Moodle Platform |
| Financed | Institute of Older Adults and Social Services (IMSERSO) | European Commission (Vitalgell-C Project, 2002) | UAM-Santander Inter-University Cooperation Program for Latin America (PUM-e, 2010–2012) |
| Session procedure | (1) Introduction; (2) Pre-test; (3) Practice and exercises; (4) Post-test; (5) Conclusions and remarks | (1) Introduction; (2) Pre-test; (3) Practice and exercises; (4) Post-test; (5) Conclusions and remarks | (1) Introduction; (2) Pre-test; (3) Readings; (4) Practice and exercise; (5) Forums; (6) Tutorial; (7) Post-test in each unit |
| Recruitment | Announcements in newspapers, on radio and in UAM promotion systems | Announcements at selected Senior Citizens' Clubs and at UAM, to Students from University Programs for Older Adults | Students from University Programs for Older Adults at the four universities |
| Participants | 240 volunteers attended the program (approximately 35 per course; Mean age = 72.3, range = 57–83, SD = 6.7; 70% women) | 155 volunteers (around 10–22 per course; Mean age = 69.9, range = 60–94, SD = 6; 76% women) | 88 volunteers: UAM ($N = 26$), La Habana University ($N = 20$), National University Autonomous of Mexico ($N = 23$) and Catholic University of Chile ($N = 19$) (Mean age = 64.2; SD: 7.57, range = 49–84; 84% women) |

to each work module. (2) Readings: these provide useful, relevant, and proven information on the various topics addressed by the program. (3) Activities: two types of activity are involved, those used to verify self-knowledge related to the readings and those that serve for planning changes to be incorporated into daily life. (4) Forums: these are designed to promote discussion among students (including inter-country discussion) and the exchange of views about the various topics taught on the course. (5) Tutorial: the course offers the assistance of a Virtual tutor, who provides information about the execution of the task throughout the course and resolves any doubts that may arise regarding the materials and program content, and an On-site tutor, who deals with the technical difficulties that may arise on using the Moodle platform.

In order to allow comparisons of our materials and methods, Tables 1 and 2 show the procedures followed and the materials (domains, units, contents as well as the assessment and practice) for the three *Vital Aging* versions.

*2.4. Vital Aging Program Hypothesis and Objectives.* Our general hypothesis was that after *Vital Aging* programs, experimental individuals, in comparison to pre-test and controls, significantly, will attain the objectives of the program as measured by the instrument administered.

Objectives are the following: (a) to teach basic knowledge how to age well; (b) to promote healthy behavioral lifestyles;

(c) to train strategies for optimizing cognitive functioning and compensating potential decline; (d) to optimize positive affect and emotion, promoting control and coping styles; (e) to promote social relationships and participation throughout the life course using new technologies.

*2.5. Teaching Materials.* "*Vital Aging*-L," "*Vital Ageing*-M," and "*Vital Aging*-e" are multidimensional courses based on the same four-domain model of active aging. Therefore, materials (units, lesson content, assessment tests, and tasks for practical work) were developed on the basis of these four domains. The *Vital Aging* e-Learning version is less extensive than *Vital Aging* Life and Multimedia, but after a general introduction, the four domains are addressed. Table 2 shows a summary about Domains and Units, together with examples of Context and Assessment tests and Practice tasks for the three versions of *Vital Aging*.

# 3. Evaluation Studies on *Vital Aging* Programs

Four evaluation studies have been carried out on Active aging programs: following Scriven, formative evaluations were conducted at the beginning of both the *Multimedia* and *e-Learning* versions; [56] also, several summative or outcome evaluations were carried out for the *Life* and *Multimedia* programs; finally, since the *e-Learning* version is quite new,

Table 2: Domains, units, contents, and assessment and practice of vital aging versions.

| Domains | Vital aging L and Vital aging M | | | Vital aging e-Learning | | |
|---|---|---|---|---|---|---|
| | Units | Contents | Assessment and practice | Units | Contents | Assessment and practice |
| | Aging well | (i) General introduction to the Course<br>(ii) Human development is lifelong<br>(iii) Use it or lose it!<br>(iv) What vital, successful, active, and productive ageing means: the four domains<br>(v) Mechanisms for aging well: the SOC model<br>(vi) Stereotypes and self-steretoypes of aging | (a) Your images about aging?<br>(b) Which are aging well mechanism?<br>(c) Level of your physical activity?<br>(d) Your social relations?<br>(e) Avoid state "I already cannot" | Aging well | (i) Active aging. Aging well<br>(ii) Stereotypes and self-stereotypes of aging (Myths and realities about aging)<br>(iii) Why "I cannot." | (a) What is aging well?<br>(b) Active aging versus aging well task<br>(c) How to identify my stereotypes and combat them?<br>(d) How I am getting old?<br>(e) Forum: Blessed versus damn old age |
| | Enjoy the Control of your life | (i) Importance of healthy lifestyles<br>(ii) The concept of health<br>(iii) How to learn new healthy habits<br>(iv) Misconceptions about health<br>(v) Health Crisis along life course<br>(vi) Risk factors: how to control them<br>(vii) Protective health factors<br>(viii) How to improve self-esteem | (a) Assess what is going well/what can be improved<br>(b) Target behaviours selection for change:<br>(1) Short term<br>(2) Long term | Take care of your body | (i) Physical activity: exercise and sport, its importance, and changes across life<br>(ii) Good nutrition characteristics<br>(iii) Take care of your teeth and your feet | (a) Identifying aging signs<br>(b) How is your fitness?<br>(c) How is your diet?<br>(d) In what extent do you take care of your teeth and feet?<br>(e) Plan your exercise<br>(f) Plan your nutrition changes, and diet<br>(g) Plan how your body caring<br>(h) Forum: You will is you can |
| Behavioral health and independence | Health and Nutrition: Good food, good life. | (i) Nutrition as one of the important aspects for health and aging<br>(ii) Food as energy. Food guide Pyramid<br>(iii) Nutrition fact<br>(iv) How to build a healthy body<br>(v) Changes in diet are required across lifespan<br>(vi) How to cook healthy recipes | (a) Assess your food information<br>(b) How calculate BMI<br>(c) Assess your nutrition<br>(d) Planning food for the next week/month | | | |
| | Taking care of your body: Self-responsibility and self-management | (i) Body changes across the lifespan: a trip through the body across time<br>(ii) Your 5 senses: where they are placed<br>(iii) The importance of your teeth and your feet<br>(iv) Self-responsibility to be independent in performing activities of daily living, choosing social contact, and personally meaningful interests<br>(v) Older adults as social capital | (a) Take your mobility test<br>(b) Take your balance test<br>(c) Plan how to improve your body care<br>(d) How to walk without risks<br>(e) How to promote and maintain ADL | | | |
| | Regular exercise: the best formula for aging well | (i) Regular physical exercise and activity as one of the best means for ageing well physically and mentally<br>(ii) Benefit of physical exercise at physiological, cognitive, emotional, and social levels<br>(iii) Aerobic, strength, flexibility, and balance | (a) In what extent you exercise?<br>(b) What do you do, what do you need?<br>(c) Selecting physical activity and exercise to incorporate into your daily life<br>(d) Make your plan<br>(e) Assess you base line and following-up | | | |

TABLE 2: Continued.

| Domains | Vital aging L and Vital aging M | | | Vital aging e-Learning | | |
|---|---|---|---|---|---|---|
| | Units | Contents | Assessment and practice | Units | Contents | Assessment and practice |
| Cognitive functioning | Train your mind: how to prevent brain ageing | (i) Change and Stability of cognitive functioning across life span (ii) Solving familiar and unfamiliar problems (iii) Managing everyday tasks (iv) Remember intended activities (v) Effects of cognitive training physical activities and psychological variables in brain functioning | (a) Test your cognitive functioning (b) Proposals of exercises and cognitive activities to train mental abilities and prevent brain ageing (c) Plan your brain training (d) Assess your base-line a continue following-up | Take care of your mind | (i) Cognitive functioning (ii) Change and Stability of cognitive functioning across life span (iii) Selection, optimization and compensation as mechanisms of adaptation to changes | (a) How do you take care of your mind? (b) Select your favourite cognitive activities. (c) Self-observation of your mental decline and stability (d) Check what you have learned (e) Plan your cognitive activity (f) Forum: Cognitive functioning among the very old |
| | Improve your memory | (i) Misconceptions about memory and ageing (ii) What is memory, how is it organized, and how does it work? (iii) Aging effects on memory. Memory problems (iv) How to improve memory through mnemonic | (a) Test your memory (b) Daily self-register of cognitive activity (c) Mnemonic skills training (d) Memory training | | | |
| | Wisdom: the expression of lifelong learning | (i) Wisdom: Lay (implicit), explicit, and expert theories (ii) Wisdom development across time (iii) Wisdom: in between intelligence and personality | (a) How you define "wisdom"? (b) Test your wisdom (c) How to train wisdom | | | |
| | The creative age | (i) What is creativity? (ii) Old people creativity (iii) Stereotypes about creative behaviour and ageing (iv) How to be creative | (a) Test your creativity (b) Choose preferred activities for expressing creativity | | | |
| Affect, control and coping styles | Self-efficacy Perception | (i) Primary and secondary control (ii) Self-efficacy as expression of control (iii) The belief of ageing successfully as predictor of aging well (iv) Self perception of aging | (a) You as a model of aging well (b) Others as modeling (c) Imageries of success (d) Solving life events across lifespan and solving life events in old age | Feel happy | (i) Emotion: pleasant activities and well-being (ii) Control and self-efficacy (iii) Coping with stress | (a) How do you feel? (b) Pleasant activities questionnaire (c) Weekly self-registration activities (d) Self-efficacy scale (e) How do you cope with stress? (f) Plan how to cope with stress |
| | Positive thinking | (i) We are what we think (ii) Attitudes and thought (iii) Thinking errors (iv) Positive thinking | (a) Test your positive thinking (b) Identify thinking errors (c) Turn negative experiences into positive ones | | | |
| | Coping with stress | (i) What is stress and anxiety? (ii) Coping with stress (iii) Active and passive coping (iv) Coping skills across life span | (a) Learn self-instructions, cognitive, emotional, and physiological coping strategies (b) How to apply them | | | |

TABLE 2: Continued.

| Domains | Vital aging L and Vital aging M | | | Vital aging e-Learning | | |
| --- | --- | --- | --- | --- | --- | --- |
| | Units | Contents | Assessment and practice | Units | Contents | Assessment and practice |
| | Death is also part of life | (i) Life and Death (ii) Bereavement (iii) Spiritual approach (iv) Transcendence (v) Meaning in life | (a) Test your fear to death (b) Think about you death (c) I think, I feel, I do. | | | |
| | Pleasant activities and well-being | (i) Activity as a source of life (ii) Feeling of depression (iii) Pleasant activities and well-being (iv) Use it or lose it | (a) Test your base line of activity (b) Plan pleasant activities: analysing resources and limitations (c) Plan and Self-monitoring your activity and well-being | | | |
| Social participation and engagement | How to improve relationships with family and friends | (i) Human relationships needs (ii) Family, friends and others: their benefits. (iii) Social relationships and independence (iv) Give and received (v) Social skills (vi) Emotional intelligence | (a) Test your social networks (b) How to improve social skills (c) Training empathy, assertiveness, say "no" say "yes" (d) Interpersonal conflict management | Get involved with others | (i) Family (ii) Friends (iii) The others: Social participation | (a) My relationships (b) Assess your social life (c) Friends' network (d) Forum: Spanish grandparents, looking after grandchildren |
| | The others need me too | (i) Importance of pro-social behaviour (ii) Stereotypes of personality changes (iii) Pro-social behaviours and well-being (iv) How to improve care relationships (v) Care and caring (vi) Volunteering | (a) Test your pro-social behaviour (b) Plan pro-social behaviours in common life (c) Train emotional self-control | | | |
| | Sexuality: beyond genitality | (i) What is sexuality? (ii) Stereotypes and social pressure in old people sexuality (iii) Sexuality beyond genitals: diverse modalities (iv) Aging and sex: physiological changes | (a) Sensitivity and sexuality (b) Train what you do not see (c) Pelvic floor muscles exercises | | | |
| | A new system of communication: Internet | (i) Healthy behaviours in computer used (ii) Stereotypes of old people using computers. (iii) Computers for hobbies, communication, navigation, and so forth | (a) How to use computers, Internet, and its different applications (b) All practice | | | |

Fernández-Ballesteros, 2002 [12] (5 Volumes); http://www.vivirconvitalidad.com/.

a pilot outcome evaluation is reported. The formative evaluation focused on the materials used, on participants' views about the course and about changes that occurred, and finally on their satisfaction. Summative or outcome evaluations were performed on the basis of quasi-experimental/quasi-control designs (pre-post with control group), in order to test the objectives of the *Vital Aging* programs; that is, the extent to which they gave rise to expected changes [57].

*3.1. Evaluation Studies.* A first evaluation of *Vital Aging* M was carried out during 2002 and 2003. This study involved a comparison between *Vital Aging*-M participants living in residential facilities ($N$ = 13, mean age = 79.3) and others living in the community (attending senior citizens' clubs; $N$ = 44, mean age = 69.9). The control group was recruited in the same contexts, from those doing other activities ($N$ = 31, mean age = 74.2). After 6 months, a follow-up of those participants living in the community was carried out. Participant characteristics, procedures, materials, and results are reported elsewhere [15].

In the second study, the *Vital-Aging*-M program ($N$ = 25; Mean age = 69.5) was compared with *Vital aging* L ($N$ = 28, mean age = 67.84). The two programs were also compared under similar quasi-experimental conditions to a control group ($N$ = 37, mean age = 65.6). Control participants were recruited from among those attending other regular activities at the Community Centre. Participant characteristics, procedures, materials, and results are reported elsewhere [13, 14].

In our third study, participants were 115 people aged over 54. Of these, 73 had attended five different editions of the *Vital Aging-M* program (mean age = 62.56, 52.2% women) and 42 had not attended the program (though they were on the waiting list), though they filled out the same questionnaire at the same point; these latter participants made up the control group ($N$ = 42, mean age = 62.29; 57.5% women) [17].

Finally, our fourth evaluation study refers to the *Vital Aging-e learning* program recently implemented (January–April 2012) and evaluated. Participants filled out the Formative and Summative protocol; only Formative results are going to be reported here, since summative evaluation is not yet finished; only some provisional data from the Spanish subsample will be reported. Sample characteristics of the four studies are summarized in Table 3.

In order to operationalize objectives two Protocols were set up with different assessment instruments administered during the program. Formative Evaluation Protocol covers the following variables: achievement tests (with the aim of checking whether there were effects on knowledge about the course units); appraisal of lessons (referring to aspects of the lesson itself); self-perceived changes (about expected changes in behavior and psychological characteristics), and satisfaction with the course. Based on the program objectives, Summative Evaluation Protocol contains a series of questions related to the following dependent variables: Views of aging (for testing changes in stereotypes and self-perceptions on aging), Activities performed (leisure, social, intellectual, cultural, etc.), Physical exercise and Nutrition (in order to assess lifestyles), Health problems, Social relationships (frequency, quality and satisfaction), and Life satisfaction. In

TABLE 3: Sample Characteristic of the four studies curried out.

| Studies | Participants | $N$ | Mean age |
|---|---|---|---|
| (1) *Vital Aging* M | Community | 44 | 69.9 |
| | Residential | 13 | 79.3 |
| | Control | 31 | 74.2 |
| (2) *Vital Aging* M versus *Vital aging* L | *Vital Aging* M | 25 | 69.5 |
| | *Vital aging* L | 28 | 67.84 |
| | Control | 37 | 65.6 |
| (3) *Vital Aging* M | *Vital Aging* M | 73 | 62.56 |
| | Control | 42 | 62.29 |
| (4) *Vital Aging* e-Learning | *Vital Aging* e-Learning | 88 | 64.2 |
| | Control | 42 | 62.29 |

our third study the following variables were also included: subjective memory, mnemonic strategies, memory appraisal, self-efficacy for aging, and positive and negative affect.

For each study, statistical analyses were carried out separately for each group, since the interest reside in observing to what extent they showed similar patterns of results, means obtained before and after each version using a repeated-measures $T$ test were performed. We also compared the pre- and post-test means of the experimental groups with that of the control group. Covariant analyses were performed in order to test potential effects of age and gender on results.

## 4. Summary of Results

### 4.1. Formative Evaluation

*4.1.1. Achievement Test.* First of all, based on the lesson's readings, trainers drew up ten questions for each lesson. Internal consistency and difficulty levels were assessed. In general, *Vital Aging-M* participants scored at least 50% correct answers in all achievement tests. Lessons yielding the highest scores were those on "Positive thinking," "Coping with stress," and "Sexual relationships: Beyond genitality." Those yielding the lowest scores (never lower than 50%) were "Creative aging," "Some basic facts about memory skills," and "Nutrition and health". These results were very helpful for improving lesson materials, since they allowed us to clear up some confusing aspects.

*4.1.2. Appraisal of Lessons.* The most positively rated lessons of *Vital Aging-M* were "Aging well" and "Taking care of your body" (both with all elements rated as equal to or above the mean score), while the lowest-rated were some of the lessons originally taught in a language other than Spanish and later translated and dubbed. All of these were rated below the mean score. Since there is a strong relationship between level of knowledge and rating of the different details of the lessons, several analyses were performed to identify which elements of the lessons are most closely related to the general level of achievement. The variable that best predicts the level of knowledge attained in a lesson is "Teacher's clarity of presentation" ($r$ = .607), followed by "Interest of

the exercises" ($r$ = .601), "Usefulness of the exercises" ($r$ = .545), and "Satisfaction with the lesson" ($r$ = .527). In any case, it should be stressed that knowledge achievement correlates positively and significantly ($\alpha$ = 0.05) with the opinions expressed.

Also, the appraisals of the lessons results were very helpful for improving materials.

*4.1.3. Self-Perceived Changes.* At the end of the Course, participants reported the degree of change they perceived, with regard to each of the units involved. The results showed that "Enjoying life in general," "Thinking positively," "Improve memory," "Feeling self-efficacy," and "Pleasant events and well-being" were the domains in which participants perceived the most positive changes. On the other hand, "A new system of communication: Internet," "Sexual relationships," "Creative aging," and "Improving family and social relationships" were the areas in which they reported minor changes.

As regards *Vital Aging e-Learning* participants, 62% reported that they had made quite a few of or many of the changes suggested in the course. Seventy-six per cent (76%) of these changes referred to emotions (positive thinking, managing stress, enjoying life in general, feel effective, enjoyable activities); 73% were related to cognitive functioning (training the mind, memory, wisdom); 69% concerned social relationships (relations with family and friends); 51% referred to lifestyles (body care, nutrition, exercise); and finally, 48% concerned participation (volunteering and Internet use). Regarding the intention to introduce changes in the future, 59% reported that they are going to incorporate some changes proposed in the program, and 35% that they would plan to incorporate very many changes.

*4.1.4. Satisfaction with the Course.* More than two-thirds of the *Vital Aging-M* course participants found the course very interesting, and no one reported low or none interest. The course met "fairly well" or "totally" the expectations of 98.8% of the participants, and 96.7% considered that the knowledge learnt had been useful or would be useful in the future. The difficulty of the course was considered low by 45.1%, while for 82.9% its content was already partially known, and 79.3% felt they had learned a great deal. General level of satisfaction was high (78.8%), and there were no participants with low satisfaction. The most negative aspect in relation to this evaluation concerns the fact that the participants scarcely consulted the reading materials available on the homepage, consulted the tutor by interview very little or not at all (78.5%), and made practically no use of the Internet at all (89.9%).

As far as *Vital Aging e-Learning* participants are concerned, 95.8% reported that the course was quite or very interesting; 80.6% considered that they performed all the program tasks proposed; 94% considered that their expectations about the course were sufficiently met; and 96% reported that the contents of the course were very helpful for improving daily living. Regarding the level of difficulty of the course, 59.7% considered the course was not easy or not very difficult, 33.3% reported that the difficulty of the program

was low, and only 6.9% perceived a high level of difficulty. Regarding satisfaction about the course, 77.5% reported that they were highly satisfied, and only 5.6% said that their level of satisfaction with the course was low. Finally, we asked participants to rate, on a scale of 1 (none) to 10 (maximum), to what extent the program would help them to grow-up as persons, the average score being 8.36 (SD = 1.93).

In summary, our formative evaluations served to improve our materials, but they also provided a subjectively positive view of the programs. Even so, our objective was not only to promote well-being, but also to produce changes in several target behaviors related to active aging, thus let introduce those outcomes.

*4.2. Summative Evaluation.* First of all, it should be emphasized that our experimental and control groups did not significantly differ in the pretest with regard to the dependent variables and both sociodemographic variables, age, and gender do not have influences in any of the dependent variables. In comparisons between pre- and post-test measures in the experimental groups and between experimental and control post-test measures, significant differences were yielded in the following variables in the expected direction.

(1) Views of aging: Those participating in the *Vital Aging* programs were assessed (both *Vital Aging*-M and *Vital Aging*-L, and those living in residences and in the community) had a significantly better view of aging after the course, and also they considered themselves more efficient for facing the aging process. No significant pre-test/post-test differences were found in our third study for views of aging.

(2) Activity level: After the implementation of both *Vital Aging* programs assessed (Life and Multimedia), participants from both contexts (Community and Residence) reported higher frequency of cultural, intellectual and social activities while not changes were found among controls.

(3) All those participants living in the community attending *Vital Aging-M* or *Vital Aging-L* did significantly more *physical exercise* and significantly improved their *diet* after the course. These positive effects were not found in those participants living in residential settings.

(4) Regarding *Vital Aging-M*, no significant pre-test/post-test differences were found in our experimental groups in either context (residence or community) for the social relationships measures. Only participants in *Vital Aging-L* and those attending the program in the third study yielded positive results, reporting significant increases in the frequency of their social relationships.

(5) With respect to life satisfaction, participants in *Vital Aging-M* living in the community reported greater differences after the program in the first and the second studies. Nevertheless, no differences were found in those participants living in residences or in those

participating in the same *Vital Aging* program in our third study.

(6) In the follow-up carried out for our first study (after 6 months), all pre-post differences in the experimental group were maintained, but, as predicted, positive changes were found in health for the community group.

(7) All of these differences remained significant when the effect of age was controlled.

(8) In the third study, after attending *Vital Aging-M* participants reported better memory and more use of mnemonics, improved their hedonic balance, experienced fewer negative emotions, and increased the frequency of their social relationships.

(9) Regarding *Vital Aging e-Learning*, preliminary results obtained in the Spain subsample indicate that following the program, participants reported greater emotional balance, and higher leisure and productive activities. All of these results are consistent with the other *Vital Aging* versions.

## 5. Discussion

Although some findings are not totally consistent (mainly for life satisfaction and social relationships), *Vital Aging* programs yield quite encouraging results. Participants enrolled on *Vital Aging-Life* and *Multimedia* had a better view of aging, in accordance with what was presented in the program units. Likewise, they more frequently enjoy cultural, intellectual and social activities than they did before the course. With the exception of participants living in residences, all the experimental groups increase their physical exercise and significantly improve their diet. The results are in accordance with those from the literature on programs promoting physical exercise and healthy diet, and are similar to previous results about activity level [28, 58, 59].

Nevertheless, these positive results on physical activity and diet were not found in the Residence group. Therefore, it can be concluded that *Vital Aging-M* had much more impact in the community than in institutions. However, although these differences in favor of our participants living in the community could be attributed to the fact that they have much less control over their institutional context than those living in the community, it should also be attributed to age, since those living in residential settings participating in our study are older than those living in the community (a general pattern for residential settings in Spain). This pattern is in accordance with findings from the general literature in the field of programs implemented in institutions and in studies comparing implementations in the community and in residences, as reported by Dwyer et al., among others [60]; nevertheless, any conclusions would be premature, since the numbers of participants in our residence group was very small.

Satisfaction or well-being is one of the targets for most programs promoting active aging. Nevertheless, while the measure in our first Summative Evaluation Protocol was life

satisfaction, *Vital Aging-M* yielded a significant increase in life satisfaction only in the community group (not in residences) in the first and second studies, with no differences found in the third study. In sum, we failed to obtain changes in life satisfaction in two of our three studies. It should also be noted that when we introduced more specific variables of affect, in our third study, the *Vital Ageing-M* participants reported more positive emotional balance; that is positive affect is significantly higher than negative in the same direction as found in other studies [61, 62]. Although much more research is necessary, our results point to the stability of life satisfaction construct do not make it as a sensitive variable for evaluation purposes, as also reported by several other authors; [63] therefore, more specific measures of satisfaction and well-being must be used.

Participants in the *Vital Aging*-M program in the third study (the only study in which we used these variables) also reported better perceived health and significantly improved their appraisal of their memory, reporting the extensive use of mnemonics, improved their hedonic balance by experiencing fewer negative emotions, and increased the frequency of their social relationships. All of these results could be attributed to two circumstances. First, after our formative evaluation we made some changes in an attempt to improve our materials, and second, we introduced new measures in order to make more specific evaluations. Much more research needs to be carried out in order to disentangle these two hypotheses.

In addition, we should highlight our results regarding health (health-related problems). This variable referred to whether participants reported health-related problems (e.g., back problems). Our prediction was that health would not change in the post-test, with changes only reported in the follow-up. As predicted, in the first and second studies there were no differences between pre-test and post-test in this variable, but in the third study, both the experimental and control groups reported fewer health-related problems in the post-test. These results cannot easily be understood. However, bearing in mind that the Live and Multimedia programs had a duration of 3 months and did not include specific medical care, changes in health could not be expected, since they would only occur as a result of changes in lifestyles: on the other hand, as expected, positive changes in were indeed observed in our first study in the follow-up at 6 months.

It should also be stressed that the *Vital Aging* programs had only minor impact upon the hypothesized variables related to control (self-efficacy for aging) and social relationships (quality and satisfaction). New analyses have been carried out in order to learn more about these results. Since our participants improved their self-images of aging in both versions—Life and Multimedia (both in the community and in residences)— in our third study we added a new measure of self-efficacy for aging. However, in this study no changes at all were found after the program, though this measure showed a high level of reliability and construct validity [27].

Finally, we must add that we expect to have the summative results from the Vital Ageing e-Learning course available soon, since post-tests have already been administered in the four countries (Spain, Cuba, Mexico, and Chile) involved. From our preliminary results from the subsample in Spain it

can be concluded that they are consistent with the other *Vital Aging* versions.

All of the studies reported here have some important limitations. First of all, our samples are small, and not representative. Our results can be generalized only to those older adults who are *willing* to age well and register in a program for promoting aging well. Second, changes produced refers mainly to immediate changes in behavioral life styles and not long term outcomes such as disability or survival and we carried out only one follow-up study, and the extent of the follow-up was quite limited. We are aware, this Program requires longer follow-up in order to test whether those changes in behaviors could produces effects on long term hard variables such as disability and healthy survival. In the near future, we are planning to follow up all our participants, since 1996, on the *Vital Aging* programs. Third, research on active aging is growing rapidly, so that active aging promotion programs cannot be "closed" in a particular set of units (or contents), since empirical evidence is increasing year on year, and new elements are continually being discovered, supported by empirical or experimental evidence, that can influence positive aging, so that they must be introduced in a flexible way. It is on the basis of this aspect that we have launched an Internet Site which can be updated for providing material to both users and professionals (http://www.vivirconvitalidad .com/). Fourth, as remarked by Fernandez-Ballesteros in a follow-up study on aging stereotypes, the media not only generate negative stereotypes in relation to the aging phenomenon, but can also produce positive changes in the mentality of new generations, embedding positive images about aging in line with the idea that individuals can be agents in their own aging process [64]. Therefore, we are aware that in the future it will be necessary to adjust the content and methodology of *Vital Aging* in accordance with a rapidly changing society—adapting them to generations of older adults who are increasingly demanding, better prepared, and better educated, so that we may need to introduce different levels of difficulty into our program. Finally, on the basis of our first study applied in Residences we have ceased the administration of *Vital Aging* in institutions, but we do believe that much more effort should be made to design a new version that could be implemented in institutions and in other settings.

Aging is an international phenomenon; it is an expression of the human being's capacity for adaptation, or plasticity—at both individual and population levels—and also a product of the level of development of our society and of its success. However, aging can also be considered a threat, as it is associated with illness and disability. National, regional and international institutions are calling for the implementation of initiatives, policies, and programs for extending health and well-being across the lifespan and into very old age, converting active aging into a kind of mantra. But active aging (or successful, optimal, productive, and *vital aging*) are also scientific concepts about which a substantial body of knowledge can be disseminated and applied at both the population and individual levels. It should not be overlooked that individuals themselves are the agents of their own development and aging, and the most important resource for change. *Vital aging* represents only a modest step forward in this direction, and this paper is no more than a way station on the long, but fascinating, path in pursuit of better aging, as we try to convince people that, as well as adding years to life, they can always add life to years.

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*Research Article*

# Active Ageing in CIS Countries: Semantics, Challenges, and Responses

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Although the CIS countries are connected together by the legacy of breaking away from the Soviet Union, they have had a distinctive transition course and are rather diverse in terms of the population ageing challenges and policy responses in place. The commonality is that a comprehensive national strategy on ageing is lacking, and many of necessary reforms were put aside owing to political uncertainties, lack of societal consensus, and financial instability. The notion of active ageing is associated with the term "accelerated ageing," which is understood to be an individual living a life under harsh living conditions or a society experiencing rapid increases in the relative number of older persons, and therefore it carries a negative connotation. Yet, in the same spirit as the European Year for Active Ageing and Solidarity between Generations 2012, the CIS countries have initiated sectoral programmes towards enhancing employment of older workers, social participation of older people in the society in a wider sense and also measures promoting health and independent living of older persons.

## 1. Introduction

The term active ageing has now occupied a central place in the international discourse on policy on ageing, particularly in the EU-27 countries which have been observing the European Year for Active Ageing and Solidarity between Generations 2012 (EY2012). It is reasonable to expect that the EY2012 would contribute to raising awareness on the European as well as international discourse on active ageing and also in informing the policy interventions required. Meanwhile, the impact of the EY2012 can be extended beyond the twenty-seven EU countries and some essential lessons can also be shared internationally, including in the immediate EU neighbourhood, the Commonwealth of Independent States (CIS) countries.

This paper is about active ageing policy discourse in the CIS countries, and is organised in six sections. After this introduction, Section 2 outlines the specific patterns of the active ageing concept used in the international policy frameworks, in the CIS countries as well as in other parts of the world. Section 3 presents the demographic outlook of these countries and highlights the diversity across CIS countries with respect to the phenomenon of population ageing. Section 4 reports on the differential extent of challenges faced by these countries, in terms of employment, social participation and capacity to live a healthy and independent life, in line with the three dimensions of the EY2012. Section 5 describes the policy approaches adopted across these countries. Section 6 provides a concluding summary.

## 2. Definitions and Regional Semantics

*2.1. Definitions and Policy Frameworks.* The various definitions of active ageing as a policy concept and a policy framework are of multidimensional (multifaceted) nature. In its 2002 milestone publication, World Health Organization (WHO) defines active ageing as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" [1]. This 2002 WHO policy framework underlines that active ageing aims to extend healthy life expectancy and have the overall objective

of improving the quality of life for all people as they age (especially those who are frail, disabled, and in need of care). It would therefore be pertinent to broaden the scope of active ageing dimensions by including, along with the productive (both remunerated and nonremunerated) work, the following activities and leisure: housework; active leisure (hobbies, sports, travel, creative activities, education, and social contacts); home-based and family-related leisure; and everyday physical and cognitive activities (such as solving crosswords and reading). The two latter areas are of particular relevance to frail older persons and older persons with disabilities [2].

The WHO Active Ageing publication has been a contribution to the Second World Assembly on Ageing (WAA), 2002. The major outcome of this WAA has been the Madrid International Plan of Action on Ageing (MIPAA) [3]. Although MIPAA does not contain an elaborated definition of active ageing, the Political Declaration signed at the end of the 2nd WAA emphasizes the two essential elements directly relevant to active ageing policy discourse: the empowerment of older persons and the promotion of their full participation. Moreover, MIPAA contains several policy recommendations pertinent to active ageing. These recommendations are concerned with the active participation in society and development (priority issue 1 of the first priority direction of MIPAA), access to knowledge, education and training (priority issue 4 of the first priority direction), and health promotion and well-being throughout life (priority issue 1 of the second priority direction).

OECD defines active ageing somewhat narrowly as "the capacity of people, as they grow older, to lead productive lives in the society and the economy." Thus the main focus of the OECD policy concept related to active ageing is to promote productive activities of older people [4]. It misses out on putting emphasis on health enhancing activities and capacity for autonomous living.

One of the most recent definitions of active ageing has been offered for the EU Year for Active Ageing and Solidarity between Generations 2012: "active ageing means growing old in good health and as a full member of society, feeling more fulfilled in our jobs, more independent in our daily lives and more involved as citizens" [5]. A more comprehensive definition comes from the background research work undertaken for the active ageing index, constructed for the European Commission and the UN Economic Commission for Europe (UNECE), in the framework of the 10th anniversary of the 2nd WAA, the 2nd cycle of review and appraisal of the implementation of MIPAA and its European Regional Implementation Strategy (RIS), and the EY2012: "Active ageing refers to the social ageing phenomenon in which, with rising life expectancy on average, people are expected and allowed to continue to participate longer in the formal labour market as well as in other unpaid productive activities (such as care provision to family members and volunteering) and live healthy, independent and autonomous lives in their older ages." The same report highlights that active ageing is also important as a determining factor of the quality of life of older people and the sustainability of public welfare systems: "in view of diversities across European countries and across subgroups, it is vital to assess not just how countries and subgroups fare in terms of actual experiences of active ageing but also measure the unrealised potential of older people that can still be tapped to improve their quality of life and to make public welfare systems more sustainable" [6].

The cumulative nature of definitions of "active ageing" allows for a broad interpretation of the corresponding policy frameworks. The 2002 WHO policy framework implies policy action in three areas: health, participation, and security.

(i) "Health" is referred to as physical, mental, and social well-being, following the WHO definition of health.

(ii) "Participation" is in turn understood as a multi-faceted array of activities by older persons in social, economic, cultural, spiritual, and civic affairs, in addition to their participation in the labour force.

(iii) "Security" is concerned with the access of older persons to physical and social environment; income security; and (when applicable) the securing of dignified work.

The UNECE identifies three areas of policy actions on active ageing, though put somewhat differently from the three areas defined by WHO but essentially capturing the three important domains: labour market participation, social integration and health.

EY2012 also seeks to promote active ageing in three broadly defined areas: employment; participation in society; independent living. Measures in the area of employment aim at creating better opportunities and employability for older workers; measures in the area of participation are to be focused on combating the social exclusion of older people by fostering their active participation in the society (by encouraging voluntary activities and support for informal carers); measures in the area of independent living should encourage healthy ageing and independent self-reliant living by emphasizing a preventive approach in health and social care, making transport more accessible, and making the environment more age friendly [7].

The differences in interpreting the meaning of "active ageing" are noticeable also in the definitions adopted at the national level. For example, in the Australian context the proposed five elements of active ageing also include financial security, in addition to being active socially, mentally, and physically, and workforce participation [8]. The Public Health Agency of Canada, on the other hand, stipulates that active ageing can be enabled by measures that support living in a safe home with adequate nutrition, having appropriate transportation and a social network, and having access to information, health, and social services [9].

Thus, the diversity of the meaning of the term "active ageing" makes the goal of identifying common grounds in discussions and in comparing policy implementation and research more complex, both internationally and nationally [8].

The definition used in the CIS countries is not devoid of similar diversities and complexities. For the analysis of the active ageing approaches in policy actions on ageing in CIS countries, a three-dimensional framework is considered most

insightful (also to be used in this paper). This framework is based on the three dimensions of promoting active ageing in the framework of the EY2012, slightly modified [7, 10]. The three policy dimensions include *employment*, *social participation in society*, and *independent* and *autonomous living* (covering preventive health care, accessible transport, and age-friendly environment). Such a framework would allow us to better capture information available on policy measures aimed towards promoting active ageing, as well as identify the most significant gaps in national policies on ageing in the CIS countries.

*2.2. Semantics in CIS Countries.* At the outset, it would be worthwhile to note that the term "active ageing" is practically of little use in the CIS countries, mainly for the fact that it can have a negative connotation in many (Slavic) languages of the CIS countries. The notion "active ageing" might almost unconsciously turn on an image of someone who has become old too fast by accelerating through his/her life course. Such an image originates from the recognition that citizens of many CIS countries belong to a society where *accelerated ageing* prevails at both individual and societal level.

  (i) At the individual level, the accelerated (i.e., "active") ageing can be attributed to living one's life under harsh living and working conditions, environmental threats (e.g., Chernobyl disaster), and poor provision of health and social services, as was the experience of many individuals during the transition period.

  (ii) At the societal level, the accelerated ageing in the CIS countries implies rapid increase in the relative number of older persons owing to low fertility (major cause of population ageing everywhere in the world), high mortality of younger people (a disastrous feature of many CIS countries), and, in some countries, such as the Republic of Moldova, mass emigration of young labourers.

A negative view of ageing in general, and the active ageing in particular, can be attributed to the legacy of the recent past and the hardships of the continuing and still incomplete transition from the communist past in many countries. Such a view might have been echoed in the recent survey of the Eurobarometer [7], which reflected more negative views of ageing (such as older persons being a burden on the society) by the citizens in the "new" Central and Eastern European member countries of the European Union as compared to the citizens of its first fifteen Western and Northern European member countries. These new member states used to belong until 1989 to the group of "socialist" countries and thus they share a legacy of the recent past with the people of the CIS countries.

The distinctive feature of activity by constraint and not by choice should also be kept in mind: low pensions for many pensioners force them to look for employment and thus additional income, and they often rely on activities such as small trade, and cottage agriculture [11]. As another example of regional semantics in CIS countries, the age beyond the retirement is often called the "age of working incapacity," and
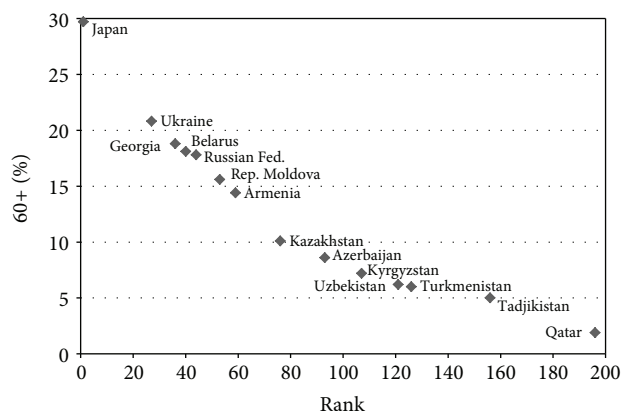


FIGURE 1: Ranking CIS countries by percentage of population aged 60+, 2009 (source: [15]).

people over the age of retirement are referred to as people "over the working age" [12].

The above considerations do not of course imply that the significance of active life style in older ages and throughout the life course is unknown or undesirable in the CIS countries. In terms of semantics, more acceptable term has been *active longevity* [13, 14] instead of active ageing. That said, we consider the notion of "active longevity" as a synonym of active ageing; therefore, in this paper we continue to use the term active ageing as prevailing in the western scientific and popular literature.

## 3. Demographic Outlook

While linked geopolitically, the CIS is a loose association of countries and they are undoubtedly very heterogeneous. This heterogeneity is particularly seen in terms of ageing of populations of these countries. Ukraine, for instance, is already among the fastest ageing countries of the world, along with the majority of other European countries. By using the indicator, the percentage of population aged 60 years or over, Ukraine in 2009 was ranked twenty-seventh, Georgia thirty-sixth, Belarus fortieth, among the 196 countries of the world (see Figure 1). In the countries of the European Union (EU), the percentage of population aged 60 years or over was in 2009 significantly higher. Among the ten most rapidly ageing countries of the world, eight were members of the EU; seventeen EU member states belonged to the group of the twenty oldest countries of the world; twenty-two EU member States were among the thirty world countries with the fastest ageing of populations. Five EU countries occupied ranks from thirty-fifth (Luxemburg) to fifty-second (Ireland).

In the same year by this indicator, Kyrgyzstan was on the one hundred-seventh position, Uzbekistan on one hundred twenty-first, Turkmenistan on one hundred twenty-sixth, and Tajikistan was one hundred fifty-sixth [15].

By the median age indicator, Ukraine in 2009 was among the top thirty countries, and Belarus and Russian Federation among the top forty, while Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan were among the countries of

Figure 2: Ranking CIS countries by median age of population, 2009 (source: [15]).

Table 1: Distribution (grouping) of CIS and EU countries by median age, 2009.
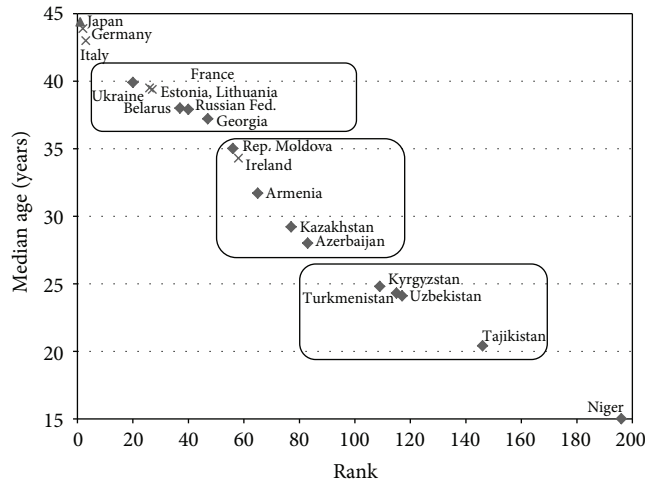
| Median age (years) | CIS countries (rank) | EU countries (rank) |
|---|---|---|
| Above 35 | Ukraine (27) Belarus (37) Russian Federation (40) Georgia (47) | Germany (2) Italy (3) Finland (4) Bulgaria (7) Austria (8) Slovenia (10) Greece (12) Belgium (13) Sweden (14) Portugal (15) Denmark (16) Netherlands (17) Latvia (19) France (20) Spain (21) United Kingdom (22) Hungary (24) Lithuania (25) Estonia (26) Czech Republic (28) Luxembourg (29) Malta (32) Romania (36) Poland (41) Slovakia (48) Cyprus (52) |
| 25–35 | Republic of Moldova (56) Armenia (65) Kazakhstan (77) Azerbaijan (83) | Ireland (58) |
| Below 25 | Kyrgyzstan (109) Turkmenistan (115) Uzbekistan (117) Tajikistan (146) | |

Source: [15].

the world on the other end of the spectrum of population ageing phenomenon (see Figure 2).

On the basis of the above two indicators, the CIS countries occupy a wide space in a continuum of the demographic transition between Japan and Qatar, in case of the proportion of 60+ population, or Niger in case of the median age. At the same time, by the indicator of median age, one can group the CIS countries in three clusters: the first cluster of countries with the median age above 35 years (Belarus, Georgia, Russian Federation, and Ukraine); the second cluster with the median age between 25 and 35 years (Armenia, Azerbaijan, Kazakhstan, and Republic of Moldova); and the third cluster - with the median age below 25 years (Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan).

All EU countries in 2009 had their median age above 35 years thus belonging to the first cluster together with the four CIS countries. Moreover, six of them, Germany, Italy, Finland, Bulgaria, Austria, and Slovenia, were in the group of the ten countries with the highest median age between 44.4 and 41.4 years. Ireland with the median age of 34 was ranked 58th (Table 1).

Significant heterogeneity of the CIS countries can also be noted in the age structure of their populations (Figure 3). The highest proportion of children (0–14 years old) in 2010 was in Tajikistan (37%) followed by Kyrgyzstan (30%) and Turkmenistan and Uzbekistan (29% each), and the lowest values of this indicator were in Belarus and the Russian Federation (15% in each country) followed by Ukraine (16%). In the group of the Western European countries [16], which includes 6 EU member states (Austria, Belgium, France, Germany, Luxemburg, and the Netherlands), the average proportion of children was 16%, the same value as in Ukraine, and slightly higher than in Belarus and the Russian Federation.

The highest proportion of persons at the age of 65 years and over was in Belarus, Georgia, and Ukraine (14% in each country) followed by the Russian Federation (13%). The lowest is observed in Tajikistan (3.5%), followed by

Kyrgyzstan and Turkmenistan (4% in each country) and Uzbekistan (5%). In the Western European countries the corresponding figure was higher −18%; with the highest value in Germany −20.4% [16].

The large and highly heterogeneous population group of persons at the age between 15 and 64 is often referred as the "working-age population" [17]. Among the CIS countries, the largest proportion of persons at this age is in Azerbaijan (73%) followed by the Republic of Moldova and the Russian Federation (both are at 72%), and Belarus (71%). The lowest
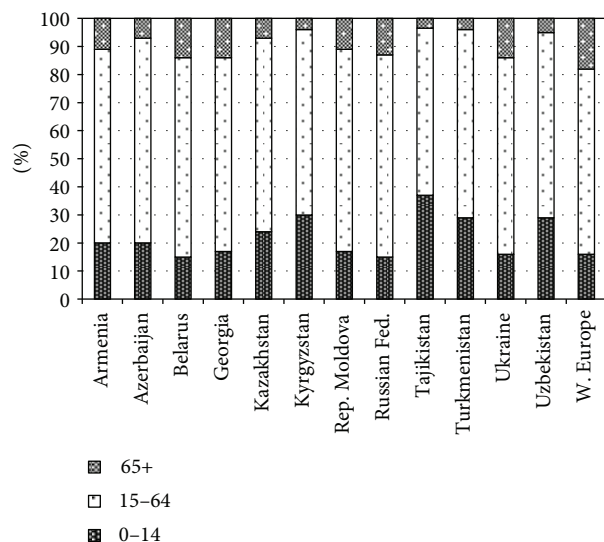
proportion of persons of this age is in Tajikistan (59.5%) owing to a relatively higher proportion of children in the population of this country. Close figures are in the three other Central Asian countries: Kyrgyzstan and Uzbekistan (66% in each) and Turkmenistan (67%). The Western European countries have the same proportion of the working age population as Kyrgyzstan and Uzbekistan. However, these even levels are owing to different population structures: the Central Asian countries have a higher proportion of children and lower proportion of persons at the age of 65 years and over, while in the Western European countries the proportion of children and persons at age 65+ are almost equal.

Of special interest is the intertemporal dynamics of the relative size of this population group during the future 15 years (Figure 4). In the majority of the CIS countries, it is projected to steadily decline with the exception of Tajikistan, Turkmenistan and Uzbekistan, where it will be growing at least until 2025. Thus, by 2025, the levels of this indicator in the CIS countries will converge from the current range between 59.5% (Tajikistan) and 72.6% (Azerbaijan), to the more "homogeneous" range between 62.6% (Tajikistan) and 68.5% (Turkmenistan). In the Western European countries, the relative size of this population will undergo a rather steep decline from the current 65.9% to 61.4% in 2025.

## 4. Challenges: Current Experiences of Active Ageing in the CIS Countries

This section reviews the situation in the CIS countries focusing on the three distinctive elements of the active ageing framework: employment, social participation, and independent living.
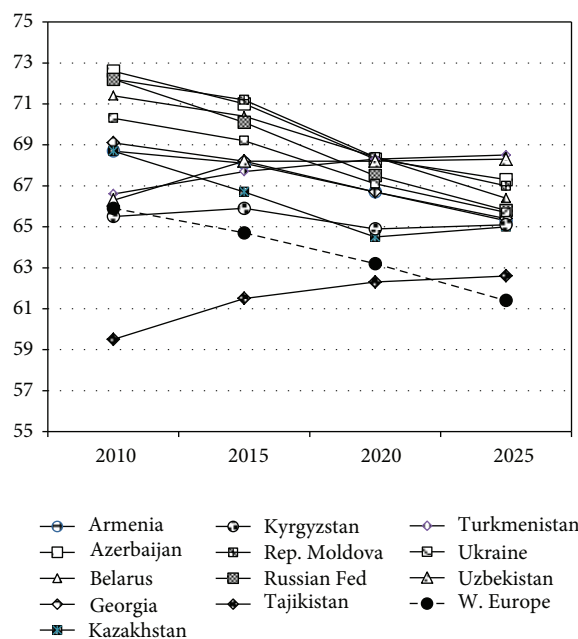
*4.1. Employment.* The labour force participation rates of persons of 65 years and over (LFP65+) is another good illustration of the diversity of the CIS countries. The differences between the countries are particularly apparent if this indicator is plotted against the time periods before and after the collapse of the USSR (see Figure 5). All CIS countries, except Belarus, had experienced a noticeable increase of LFP65+ during the decade 1990–2000. The highest increase was recorded in Tajikistan (16.9%), followed by Georgia (14.4%) and Uzbekistan (13%). In Ukraine, the comparable increase occurred in the following decade 2000–2009, when most of the CIS countries had undergone the reversal of the LFP65+ to the pretransitional levels. Moreover, the LFP65+ levels in Ukraine, as well as in the Republic of Moldova, are projected to grow during the decade leading to 2020.

However, the situation concerning employment of persons of postretirement age in Ukraine, and most probably in many other CIS countries, can to a great extent be explained by a widespread employment of older age groups within the less prestigious jobs, and accordingly with minor competition from labour supply. Most of such jobs are available in the informal economy, but also at the state enterprises [18].

The distinctive patterns of the LFP65+ indicators are apparent in Belarus and Georgia. In Belarus, the levels of the LFP65+ have been the lowest among the CIS countries and very close to the corresponding figures in countries of the Western Europe. Note also that the LFP65+ in Belarus has been steadily declining since 1990. Meanwhile, the government of Belarus has recently reported the increase in the labour force participation of persons above the retirement age (55 years for women and 60 years for men) during the period of 2007–2010 [19]. In the Western European countries, where LFP65+ indicator has been much lower than in most CIS
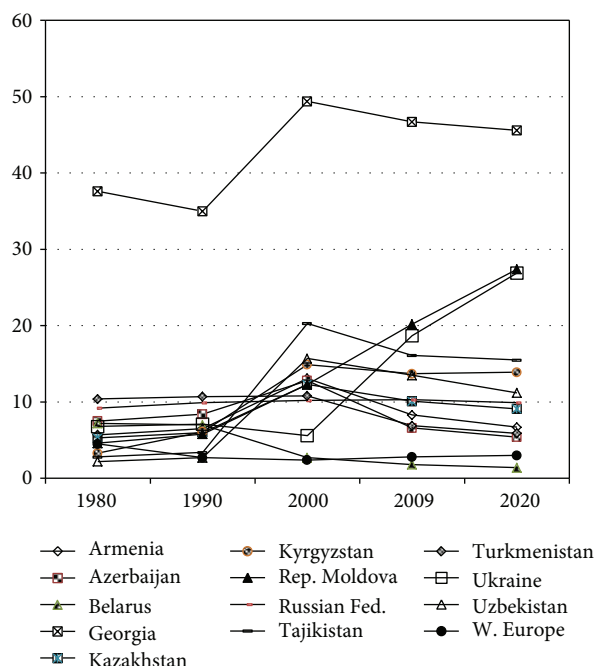
FIGURE 5: Labour force participation of persons at 65 years and over, %, 1980–2020 (source: [15]).

countries, it has also undergone an increase during the most recent decade 2000–2009.

The Georgian case seems to be truly exceptional: not only this country had the highest level of LFP65+ before the transition, but it also recorded one of the highest degrees of increase in this indicator. Even in 2009, after some decline, LFP65+ in Georgia remained the highest among the CIS countries. The special case of Georgia can be explained by the possible influence of armed conflicts and border disputes that exacerbated the economic shock following the collapse of the USSR. As noted elsewhere, the effect of these factors could be seen most dramatically in the Caucasus region, where real GDP per capita virtually halved between 1991 and 1993 [20]. In contrast, Belarus before the transition (in 1989) had the highest level of GDP per capita among the Republics of the former Soviet Union, while between 1989 and 2002 the decline in its real GDP per capita was the smallest among the CIS countries. Thus, Belarus in 1999 had the lowest levels of poverty, including the level of absolute poverty, among the CIS countries [20]. Taken together, the above observations may indicate that in the CIS countries the high level of labour force participation of older persons, one of the experiences of active ageing, could reflect the individual adjustment to economic hardship rather than the informed response to policy incentives for continuing employment in older ages.

Any consideration of the employment situation of older persons in the CIS countries would be incomplete without recognizing that a significant, and in some countries even a predominant, portion of economy operates informally. Indeed, the size of the informal sector of economies in CIS countries in early 2000s might have varied from 30% to more than 60% of GDP [20]. In Kazakhstan, in 1999,

the self-employed made up 45.1% of the total able-bodied population [21]. Many older workers who are employed work in the informal sector. This could be explained by the difficulties that older workers face in getting good jobs, and the possibilities of supplementing very low pension benefits with incomes from unregistered employment [22]. Again, the predominant role of economic necessity rather than incentives could also be seen behind this component of active ageing in the CIS countries. As noted in the 2012 national report of Ukraine on implementing the RIS/MIPAA, *"addressing the problem of the older people's efficient employment in Ukraine is more problematic compared to developed countries because of the archaic economic structure, prevailing traditional low-technology and labour intensive productions, widespread outdated technologies and equipment, harmful or arduous conditions of work, which by no means promotes long-term preservation of health and working capacity"* [18].

*4.2. Social Participation.* Data on the *social participation* of older persons in the CIS countries is scarce and unsystematic. The *content* and *forms* of *participation* of older persons as well as persons of other ages in the CIS countries have profoundly changed since the collapse of the Soviet Union. The essence of this change has been a shift from the collective to the individual forms of participation, predominantly in the family and also within the small networks of friends and acquaintances. As revealed in the 2008 wave of the European Values Study [23], the overwhelming majority (96%) of adults (18+ years old) in Russia put the family on the first place in the hierarchy of their values, followed by friends (85%) [23]. Participation in the family life and various contributions to its welfare, particularly through grandparenting, has substituted many other forms of participatory activities of older persons. While other forms of participation of older persons, as well as members of other age groups, have diminished after the collapse of the Soviet Union, this deeper attachment of older persons to the family life has been metaphorically referred to as "withdrawal to the family" [24].

Following the dismantling of the Soviet Union, the powerful top-down government-controlled organizations of older persons had been replaced by and in some cases transformed into the bottom-up initiatives and movements. During the Soviet period, there were long-established councils for war and labour veterans, operating at local municipal, regional, and national level, but these were essentially formal, politically managed agencies. During the years of transition, in some CIS countries, those councils have become more involved in the advocacy work on behalf of older persons, and in Ukraine some of them used to be represented in the parliament [25]. Moreover, in the Russian Federation and Ukraine, the parties of pensioners were established, and the Russian Party of Pensioners even entered the national parliament in 1999 [26]. As noted elsewhere, pensioner parties appeared to perform somewhat more successfully in the postcommunist Central and Eastern Europe than in the west European democracies [26]. The sporadic emergence of the new political and social organizations of older persons in the CIS countries during the post-communist transition can

be driven by an abrupt collapse of welfare states and bottom-up attempts to replace them with self-help initiatives. Similar wave of new organizations of older persons was seen in Western Europe from 1970s in response to the "new politics of old age," which was in turn created by the twin processes of population ageing and the contraction and reconfiguration of postwar welfare states [27].

Generally, in the CIS countries older persons are more politically active than the representatives of younger generations. In Kazakhstan, for instance, the share of the population that participates in the parliamentary elections increases with age, with 71.8% of those older than 65 voting, and only 52.4% in the age group 35–40 vote [21]. At the same time, older persons in Kazakhstan practically do not participate in the work of NGOs since these organizations are viewed negatively as supporting their respective organisers and not caring of their members [21]. Similar situation is noted in Tajikistan, where older persons after retirement are leaving the public life: only 5.7% took part in political organizations; 2.7% attended various clubs (e.g., sport clubs), 1.6% attended various exhibitions [28]. The situation is not much different in other CIS countries. In the Russian Federation, for instance, only 1% of persons at the age 55–69 years participated in the work of public organizations, and between 1% to 4% attended various cultural events [29].

People in the CIS countries also get involved very often in the volunteering work, including older persons. Interestingly, Turkmenistan was ranked number one among 153 world countries by the proportion of volunteers in a representative sample of individuals living across the country, who participated in the Gallup's World Poll survey in 2011 (see Table 2) [30]. Three other CIS countries from Central Asia (Kyrgyzstan, Tajikistan, and Uzbekistan), along with Belarus, were among the top twenty countries with the highest proportion of volunteers. Other seven CIS countries have been randomly distributed among various countries, including EU countries. There is a specific pattern in volunteering by the CIS persons in the upper age bracket of the Gallup's survey (50+ years old): the proportion of volunteers in this age group is lower than among the individuals in the total survey sample. No such uniform pattern is seen in the group of EU countries.

*4.3. Capacity for Independent Living: Health and Life Expectancy.* In considering the component of independent living, we have focused on health as it captures best the independence aspect for older people and also this parameter has the most distinctive features and significance in the CIS countries. All CIS countries since 1991 have experienced the deterioration of health of their populations, albeit of different severity and during the different periods and length of time. The demographic and epidemiological patterns, and to some extent the medical, social, and economic mechanisms of this health decline, have been widely acknowledged and analysed in numerous publications [31–34]. The causes of the mortality crisis have been sorely investigated in the most affected Russian Federation, while the situation in other CIS countries has mostly escaped the attention of the international community. Below, we summarize the major demographic parameters of the health crisis in the CIS

countries after the collapse of the Soviet Union, as it has implications for people's ability to live independently.

Life expectancy at birth (LE-B) in CIS countries is significantly lower than in other countries of the European Region of WHO (see Figure 6(a)). The average total (men and women combined) LE-B in the CIS countries in 2008-2009 was 6.5 years (−9%) lower than the average LE-B in the European Region; moreover, for men this indicator was 8 years lower (−11%), and for women 5 years lower (−6%). The differences are even more apparent between the CIS countries and the 15 European countries that joined EU before May 2004 (EU-15): the total LE-B is 12 years (−15%) lower in CIS countries than in the EU-15 countries, men's LE-B is 14 years (−18%) lower, and LE-B for women is 9 years (−10%) lower.

With age, the gap in absolute figures of life expectancy between the CIS and other European countries diminishes, while the differences in relative figures become even more apparent. The total life expectancy of persons of 45 years of age (LE-45) from the CIS countries (see Figure 6(b)) is 5 years (−15%) shorter than the average LE-45 in the WHO European Region; for 45 years old men this difference is 6 years shorter (−19%), and for 45 years old women 4 years shorter (−11%). Comparing to the citizens of EU-15, the citizens of the CIS countries of the same, 45 years of age, live 8 years less (−22%): men live 10 years less (−29%), and women 7 years less (−17%).

The differences in life expectancy of 65 years old (LE-65) from the CIS countries and from the entire WHO European Region are the following: (−)3 years (−17%) in total LE-65; (−)4 years (−25%) in men's LE-65; (−)3 years (−16%) in women's LE-65 (Figure 6(c)). The differences with the EU-15 countries are again more pronounced: (−)5 years (−25%) in total LE-65; (−)6 years (−33%) in men's LE-65; (−)5 years (−24%) in women's LE-65.

The decline in life expectancy in the CIS countries is one of the most obvious and tragic attributes of the transition years that followed the collapse of the USSR. Indeed, from 1990 to 1995, the five-year period during which the USSR ceased to exist, LE-B had dropped in almost all the CIS countries (see Figure 6). As was pointed elsewhere, mortality among Russian men in "productive age" is as high as it was 100 years ago [35]. The exceptions from the mortality crisis were Georgia and the Republic of Moldova, where it had not changed, and Kyrgyzstan, where LE-B had even increased slightly (by 0.2 years) comparing to the preceding five years (1985–1990). In absolute figures, the biggest decrease during that period was in the Russian Federation (−2.5 years) and Azerbaijan (−2.2 years). In Kazakhstan, the LE-B decline peaked during the next five year period (1995–2000) and was of the same level (−2.5 years) as in the Russian Federation during the preceding five years.

The longest period of decline had been in the Russian Federation, where it had lasted for 15 years, until 2005; in Belarus, Kazakhstan, and Ukraine it had lasted for ten years, until 2000. During the periods of decline, LE-B dropped in Kazakhstan by 4.4 years; in the Russian Federation by 4.2 years; in Ukraine by 3.2 years; and in Belarus by 3.1 years. For men's LE-B the decline was even more manifest: (−)5.3 years in the Russian Federation; (−)4.9 years in Kazakhstan;

Table 2: CIS and EU countries ranked by the percentage of population volunteering time, 2011.

| Volunteering time ranking | Country | Volunteering time (%) | | | | |
|---|---|---|---|---|---|---|
| | | Total population | Years old | | | |
| | | | 15–24 | 25–34 | 35–49 | 50+ |
| *1* | *Turkmenistan* | *61* | *64* | *62* | *60* | *59* |
| *4* | *Tajikistan* | *44* | *40* | *49* | *48* | *38* |
| *7* | *Uzbekistan* | *41* | *39* | *40* | *47* | *37* |
| 13 | Ireland | 38 | 36 | 33 | 38 | 40 |
| 15 | Netherlands | 37 | 31 | 31 | 38 | 40 |
| *16* | *Kyrgyzstan* | *36* | *37* | *35* | *43* | *27* |
| *18* | *Belarus* | *35* | *31* | *36* | *40* | *34* |
| 21 | Slovenia | 34 | 45 | 32 | 30 | 34 |
| 28 | Finland | 30 | 21 | 33 | 40 | 29 |
| *28* | *Ukraine* | *30* | *41* | *34* | *36* | *19* |
| 31 | Luxembourg | 29 | 25 | 21 | 25 | 35 |
| 32 | United Kingdom | 28 | 33 | 21 | 28 | 29 |
| 37 | Austria | 27 | 24 | 31 | 27 | 26 |
| 37 | France | 27 | 22 | 18 | 27 | 31 |
| 42 | Belgium | 26 | 23 | 25 | 30 | 25 |
| 42 | Cyprus | 26 | 27 | 36 | 26 | 24 |
| 42 | Germany | 26 | 24 | 23 | 28 | 26 |
| *47* | *Kazakhstan* | *25* | *31* | *24* | *26* | *19* |
| 47 | Malta | 25 | 31 | 22 | 26 | 23 |
| 52 | Denmark | 24 | 17 | 18 | 24 | 28 |
| *58* | *Azerbaijan* | *23* | *25* | *26* | *23* | *19* |
| *58* | *Russian Fed.* | *23* | *30* | *23* | *24* | *18* |
| *64* | *Georgia* | *21* | *19* | *19* | *29* | *18* |
| *64* | *Rep. Moldova* | *21* | *20* | *33* | *24* | *12* |
| 78 | Czech Rep. | 18 | 18 | 22 | 21 | 14 |
| 78 | Latvia | 18 | 13 | 19 | 23 | 15 |
| 78 | Spain | 18 | 18 | 18 | 20 | 16 |
| 92 | Slovakia | 16 | 14 | 19 | 15 | 16 |
| 99 | Estonia | 15 | 13 | 20 | 16 | 13 |
| 101 | Italy | 14 | 16 | 12 | 18 | 11 |
| 110 | Poland | 13 | 17 | 17 | 10 | 11 |
| *119* | *Armenia* | *11* | *12* | *14* | *12* | *8* |
| 119 | Sweden | 11 | 10 | 15 | 12 | 11 |
| 127 | Portugal | 10 | 9 | 17 | 9 | 9 |
| 133 | Lithuania | 9 | 11 | 3 | 14 | 7 |
| 135 | Hungary | 8 | 5 | 12 | 8 | 9 |
| 146 | Bulgaria | 5 | 6 | 3 | 10 | 4 |
| 146 | Romania | 5 | 10 | 4 | 3 | 4 |
| 153 | Greece | 3 | 2 | 2 | 6 | 2 |

"Volunteering time in %" is a proportion of respondents that have positively responded to the question: "Have you volunteered your time to an organization (in the past month)?"
Source: [30].

(−)4.2 years in Ukraine; (−)4.1 years in Belarus. It should also be noted that in the recent years the life expectancy indicators in many CIS countries have shown some improvement (see Figure 7), while it will take longer time to see whether this trend is stable.

The investigators of the causes and mechanisms of the health crisis in the CIS countries, and particularly in the Russian Federation, have unanimously pointed to several factors, namely, heavy alcohol consumption, smoking, a high-fat diet, lack of leisure-time exercise, and hazardous working conditions [21, 34, 36]. Another important factor has been severe underfunding of public health care services that has put additional strain on the private out-of-pocket spending of the increasing impoverished segments of population in the CIS countries [22]. The total health expenditure in the Russian Federation in 2007-2008 was 5.3 percent of GDP, significantly below the levels observed in countries with similar per capita income [37]. In much less prosperous Tajikistan, this figure is even smaller: 3.5% of GDP [28]. The Russian Federation also spends less on health in per

(a)

(b)

(c)
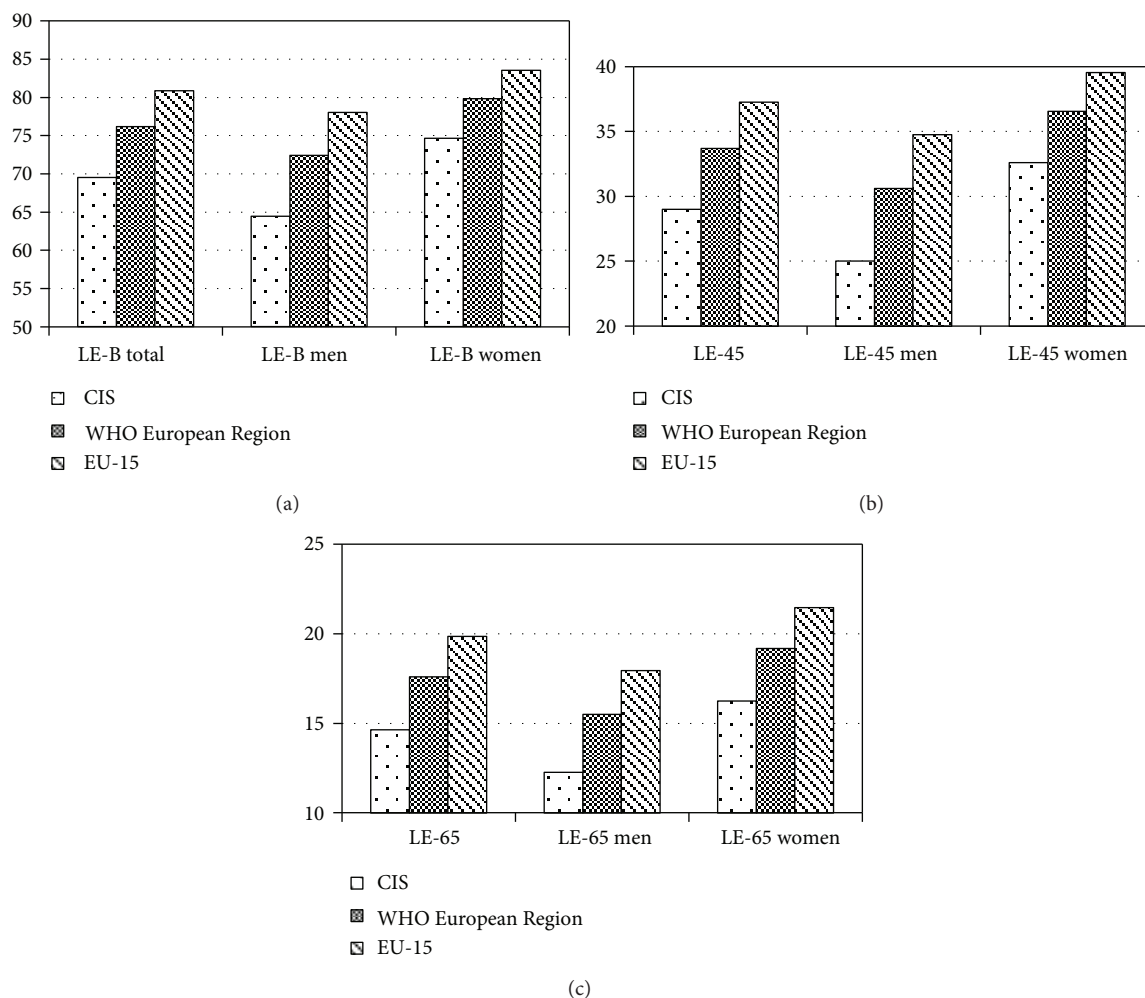
FIGURE 6: Life expectancy at birth (a) 45 years of age (b) and 65 years of age (c) 2008-2009 (Source: WHO Regional Office for Europe, European health for all database (HFA-DB) (http://data.euro.who.int/hfadb/shell_en.html). Note: the European region of WHO includes 53 countries: all European countries, all CIS countries, and also Israel and Turkey (http://www.who.int/about/regions/euro/en/index.html). EU-15 bloc of countries are: Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and Sweden.

capita terms than other countries in the G-8 group and EU countries: 4.5 times less than Japan and 12 times less than USA. Not only health spending is low but also its outcome is low, too: health outcomes in Russia are similar to countries which spend 30–40% less on health. This is one of the evidences poor effectiveness and efficiency of the health care system organization and delivery in the Russian Federation [37].

The decline of the life expectancy and increase of the mortality in the CIS countries have been extraordinary following the collapse of the Soviet Union. It is worth pointing out that this decline was present, while not acknowledged, in the USSR long before the beginning of the transition (see Figure 7). This phenomenon was also pointed out by others [36]. Thus one can suppose that the shocks and pressures of the transition were the secondary triggering forces rather than the primary initiating mechanisms of the unprecedented peaceful time mortality crisis in the CIS countries. At this

point, we can only speculate which of the great communist experiments in the USSR such as upturning the virgin soil and constructing the Baikal-Amur rail road might have disrupted the "normal" flow of the demographic process and brought the peoples of the soviet empire at the verge of the ethnosocial catastrophe.

Another observation of a particular importance within the context of this paper is that during a few years following the antialcohol campaign of 1985, the mortality in many Republics of the USSR dropped and life expectancy noticeably increased (see Figure 7). The impact of this campaign points to the power of appropriate policy measures to overwhelm and prevent the negative social processes and thus to "normalize" the national demographic outlook. It was shown that behavioural factors are responsible for the 50% of difference in the mortality levels between the Russian Federation and the developed countries [38], and therefore combating those factors should be the focus of policy actions.

FIGURE 7: Life Expectancy at Birth in the CIS Countries, 1950–2015, medium variant (source: [16]).

Another promising example is the rapid decline of mortality in the countries of the Central and Eastern Europe after the collapse of the Berlin wall, which could be attributed to political, social, and economic change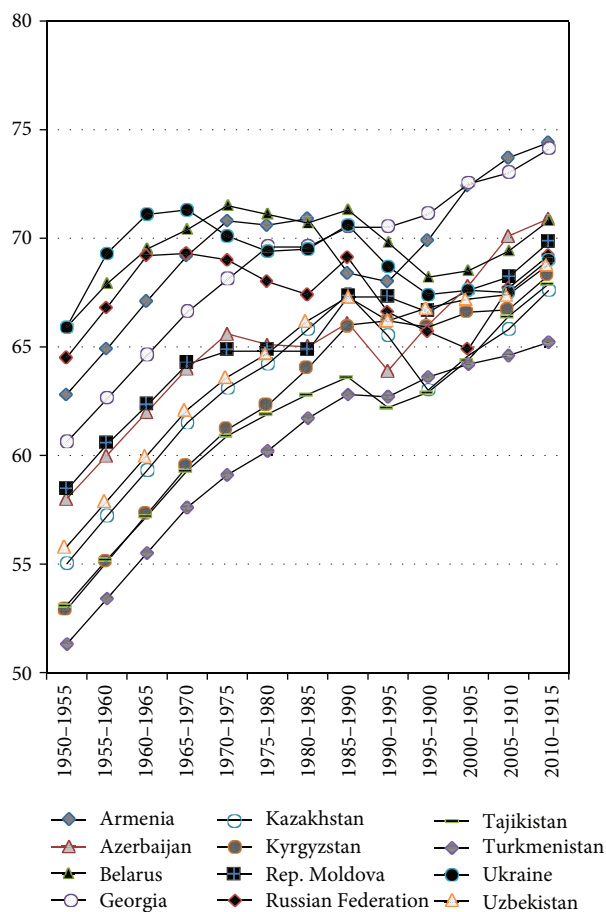s [39]. A reasonable conclusion is therefore that policies for active ageing, and particularly those aimed at promoting healthy life styles, will be a good choice for the CIS countries.

## 5. Responses: Policies for Active Ageing in the CIS Countries

In spite of the demographic heterogeneity noted above, almost all governments of the CIS countries consider population ageing an important policy issue. That was the finding of the two surveys undertaken in 2007 and 2009 within the ongoing monitoring of national population policies by the United Nations Population Division [40, 41]. The results of the most recent 2009 survey revealed that all the CIS countries are concerned with the ageing of their populations (see Table 3). Out of the twelve CIS countries, ten consider population ageing to be a major concern and other two countries consider population ageing to be a minor concern. It is worth noting that in a short period of two years between the previous 2007 survey and the most recent 2009 survey,

the governments of two countries, namely, Tajikistan and Turkmenistan, have raised the level of their concern of population ageing from "no concern" to "minor concern."

Ten out of twelve CIS countries consider the level of life expectancy at birth in their countries unsatisfactory, and only two, Armenia and Uzbekistan, are satisfied with their expected life expectancy. Armenia declared the "acceptable" level in 2009 survey as by that year it had achieved the highest level of life expectancy for men (70 years) and women (77 years) among the CIS countries. The second country whose government is satisfied with the life expectancy of its citizens is Uzbekistan, although the life expectancy in this country is relatively modest: 65 years for men and 71 years for women.

The CIS governments' views on the relative size of the working age population appear quite diverse: six out of the twelve countries expressed major concern about the size of their working age population; three countries expressed minor concern; the other three countries had no view on this issue. Interestingly, the countries that expressed the same level of concern belong to different stages of demographic transition: the major concern was expressed by Belarus, Kazakhstan, the Russian Federation, Tajikistan, Ukraine, and Uzbekistan; the minor concern was expressed by Armenia, Azerbaijan and Kyrgyzstan; Georgia, the Republic of Moldova, and Turkmenistan had "no view" on this population issue.

The above evidence suggests that the views of the CIS governments on the ageing of their countries' population are somewhat disconnected from the demographic reality in their countries. It is difficult to detect apparent relations between the values of an indicator pertaining to a particular population issue (such as changes in life expectancy) and the government view of it. One possible explanation of this contradiction is that governments' views are more often influenced by the political considerations than anything else. Indeed, drawing a distinction between "policy" and "politics" in many ex-Soviet countries has been a daunting task as the old practice of the opinion-based policy formulations often prevails over the approach of the evidence-informed policy making.

It is also necessary to mention that several CIS countries have been seriously concerned with the ongoing decline of their populations owing to the low fertility accompanied by the relatively high mortality. The largest absolute population declines among the CIS countries are expected in the Russian Federation, followed by Ukraine [22, 42]. Five CIS countries have registered annual decline of their populations in 2009: Belarus (−0.5%), Georgia (−1.1%), the Republic of Moldova (−1%), the Russian Federation (−0.4%), and Ukraine (−0.7%). Negative population growth has a particularly significant political connotation in these countries, fuelling the debates on the threat of depopulation and prompting policy measures aimed at raising the fertility rates. Practically all countries of the former Soviet Union address this challenge through pronatalistic policies and programmes. Population cohorts of higher ages, including older people and even people of working age, are traditionally overlooked from such policies.

TABLE 3: Views of the CIS governments on selected population issues, 2009.

| Country | Population Issue | | |
|---|---|---|---|
| | Ageing | Life expectancy at birth | Size of working age population |
| Armenia | Major concern | *Acceptable* | *Minor concern* |
| Azerbaijan | Major concern | Unacceptable | *Minor concern* |
| Belarus | Major concern | Unacceptable | Major concern |
| Georgia | Major concern | Unacceptable | — |
| Kazakhstan | Major concern | Unacceptable | Major concern |
| Kyrgyzstan | *Minor concern* | Unacceptable | *Minor concern* |
| Republic of Moldova | *Minor concern* | Unacceptable | — |
| Russian Federation | Major concern | Unacceptable | Major concern |
| Tajikistan | *Minor concern* | Unacceptable | Major concern |
| Turkmenistan | *Minor concern* | Unacceptable | — |
| Ukraine | Major concern | Unacceptable | Major concern |
| Uzbekistan | Major concern | *Acceptable* | Major concern |

(—): no view expressed.
Source: [41].

In this section we will also identify what policy responses to the challenges of population ageing are in place in the CIS countries. As the major source of information, we have used the national reports that the CIS countries submitted within the context of the review and appraisal of the Madrid International Plan of Action on Ageing (MIPAA). Since the adoption of MIPAA in 2002, the global review and appraisal exercise has been undertaken every five years: the first one was completed in 2007, and the second one is currently going on and will be completed in 2013. Within the first review and appraisal exercise, six CIS countries submitted their national reports: Armenia, Azerbaijan, Belarus, the Republic of Moldova, the Russian Federation, and Uzbekistan [43]. In the time of writing this paper, also six CIS countries submitted their reports for the second review and appraisal of MIPAA: Armenia, Belarus, the Republic of Moldova, the Russian Federation, Tajikistan, and Ukraine [44].

During the ten years after the Second World Assembly on Ageing in Madrid, all the reporting CIS countries had been elaborating and implementing various sectoral policies and programmes on ageing and older persons. Besides pursuing sectoral policies, several CIS countries, Armenia, Azerbaijan, Belarus, and the Republic of Moldova, have also undertaken measures aimed at *mainstreaming* the issues of ageing into their national development policies.

Within the first implementation cycle (2002–2007), several policy priorities can be identified in CIS countries (see Table 4), with the three policy areas mentioned most often: *health and medical care* (6 countries) *social protection/income security*, and *integration and participation in societal life* (5 countries each).

During the second implementation cycle (2008–2012), the order of priorities had changed slightly. While *health and medical care* had remained among the top priorities (mentioned by five countries), two other policy areas, *social protection/income security*, and *social services,* had come at the

top of the priority list as they had been mentioned by all of the six reporting countries.

Even though not staying at the top of the list of priorities, another policy area, *social services*, has drawn much of the government attention. The essence of reforms of social services, including those targeting older persons, has been the replacement of categorized universal benefits by the targeted means-tested payments. In many cases, however, this proved to be a daunting task, including for administrative logistics, for the fact that numerous social benefits were administered by various government offices with vaguely defined entitlements, poorly monitored payments and weak, if any, interministerial coordination [45, 46].

Many CIS countries engaged in reforming the policies on ageing are challenged with the task of making them financially affordable. Hence, an increasing attention has been paid by some governments to the role of the family in care giving and reciprocal income security. The expectations are that this approach would save financial resources from being spent on much more expensive programmes of institutional care and formal income security. There is also a belief that the traditions of the extended family to care for its older members are still alive or could be revived in the Central Asian and Caucasian countries, and also in the Republic of Moldova [47]. At least three CIS countries, Armenia [48], Kazakhstan, and the Republic of Moldova [49], are implementing or considering policy measures focusing on the family as a major provider of services and resources for its members, including older persons [50]. For instance, in Armenia, as taking care for the older generation is among the most important values in the Armenian society, the social services support has been granted mainly to lonely old aged people (including those who have children but living alone and also those without children).

The content of policy action varied within each policy area between different CIS countries. We have focused our

TABLE 4: Areas of policy priorities on ageing in CIS countries, 2007, 2012.

| Priority area | 2007 | | 2012 | |
|---|---|---|---|---|
| | Number of countries quoted the priority area | Quoting countries | Number of countries quoted the priority area | Quoting countries |
| Health and medical care | 6 | AM, BY, AZ, BY, MD, RU | 5 | AM, BY, MD, RU, UA |
| Social protection/income security | 5 | AM, AZ, BY, MD, RU | 6 | AM, BY, MD, RU, TJ, UA |
| Integration and participation in societal life | 5 | AM, AZ, BY, MD, RU | 3 | AM, BY, RU |
| Rights of older persons/antiage discrimination | 4 | AZ, MD, RU, UZ | 3 | AM, MD, UA |
| Social services | 4 | AZ, BY, MD, RU | 6 | AM, BY, MD, RU, TJ, UA |
| Developing (strengthening) institutional infrastructure | 3 | AM, AZ, RU | 1 | MD |
| Labour market measures | 3 | MD; BY; RU | 2 | AM, BY, MD |
| Social care, including long-term care | 2 | AM, RU | 4 | AM, MD, TJ, UA |
| Intergenerational cohesion (solidarity) | 2 | MD, UZ | 3 | BY, MD, RU |
| Promoting positive image of ageing and older persons in society | 2 | AM, RU | 2 | BY, RU |
| Sociocultural needs | 2 | AZ, AM | 4 | AM, MD, RU, UA |
| Research on ageing | 2 | AZ, RU | 3 | BY, RU, UA |
| Providing secure and affordable living environment | 2 | AM, UZ | 4 | AM, BY, MD, UA |
| Affordable and accessible transportation | 2 | AM, MD | 2 | RU, UA |
| Promoting life-long learning | 1 | MD | 4 | AM, BY, RU, UA |
| Adjusting public finance policy to demographic ageing | — | — | 2 | RU, UA |

Abbreviations used: Armenia (AM); Azerbaijan (AZ); Belarus (BY); Republic of Moldova (MD); Russian Federation (RU); Tajikistan (TJ); Ukraine (UA); Uzbekistan (UZ). Source: [43, 44].

instrumental analysis of those national policies which could be related to promoting the active ageing concept within the three dimensional framework of the EY2012 (as mentioned above): employment, social participation, and independent living. The findings are summarized in the Table 5.

*5.1. Employment.* Within the employment area, the EY2012 framework envisages measures aimed at *tackling early retirement*, *promoting flexible retirement*, and *providing incentives for extending working life*. Most of the CIS countries have undertaken various parametric reforms of their ex-Soviet defined-benefit pension schemes. Nine CIS countries, most recently (in 2011) Ukraine, have already increased the legal retirement age [46]. Similar measures have been under consideration in Belarus, the Russian Federation, and Uzbekistan. Notable exceptions from the prevailing parametric approach to reforming the pension systems has been Kazakhstan, where in 1998 a fully funded defined contribution scheme was introduced, as well as Kyrgyzstan and the Russian Federation, which have introduced some elements of the notional defined contribution scheme [17, 51]. Meanwhile, in the Russian Federation, the increase of retirement age and corresponding involvement of older workers in regular

employment is not seen as a valuable option for improving the labour market situation [52].

Among the financial incentives for continuing employment introduced in the CIS countries are also various financial and judicial (antidiscrimination) measures. The pension legislation of the Russian Federation and Ukraine, as well as of some other CIS countries, provides for the right of working pensioners to receive their full pension along with the income from their work. In Russia, the size of pensions of the working pensioners is recalculated once every several years taking into account additional pension accruals.

In the recently (December 2011) drafted *Strategy on Ageing Issues and Social Protection of Older Persons*, the government of Armenia is planning to combat the age discrimination in employment and provide more favourable conditions for the older employees in the work place, for example, more flexible working schedule.

In Belarus, the legislative measures to promote participation of older persons in the labour market have focused on preretirees and "young" (age 55–60) retirees. Such measures have aimed at adjusting labour market for making it more inclusive for various social groups, including people of older ages, by providing training programmes and psychological

Table 5: Policy measures promoting active ageing in the CIS countries.

| EU Framework for the EY2012 | Approaches to promoting active ageing | Policy measures by CIS countries 2002–2007 | Policy measures by CIS countries 2008–2012 |
|---|---|---|---|
| Employment | Tackling early retirement | (i) Increasing age of mandatory retirement (AM 1996, AZ, TJ 2005) | (i) No compulsory retirement (BY)<br>(ii) Increasing age of mandatory retirement (UA 2011) |
| | Promoting flexible retirement | (i) Employment assistance and retraining (BY, MD, RU)<br>(ii) Coordination of employment services and social services (BY)<br>(iii) Psychological support to older job seekers (RU) | (i) Favourable and flexible conditions (AM, UA)<br>(ii) Employment assistance (RU) |
| | Providing incentives for extending working life | (i) Support to preretirees and "young" retirees (BY) | (i) Combating discrimination (AM; RU)<br>(ii) Competitiveness in the labour market (BY)<br>(iii) Incentives for extending working life (RU, UA) |
| Participation | Encouraging voluntary activities | — | (i) Help and self-help groups (BY, MD, UA)<br>(ii) Intergenerational volunteering (MD) |
| | Supporting informal carers | (i) Monthly allowances for family carers (BY, RU)<br>(ii) Training care volunteers and family members (RU, UA)<br>(iii) Pension coverage (BY) | (i) Training of care volunteers and family members (BY, UA)<br>(ii) Monthly allowances for family carers (UA)<br>(iii) Pension coverage (UA) |
| | Recognizing contribution | (i) Promoting positive image (AM, RU) | (i) Promoting positive image (BY)<br>(ii) Recognizing contribution (RU) |
| Independent living | Promoting life-course preventive approach in health care | (i) Free medical care (AZ, BY, RU)<br>(ii) Free service in policlinics (AM)<br>(iii) Discounts for medicines (AM, AZ, RU)<br>(iv) State programmes for promoting healthy life style (BY)<br>(v) Geriatrics services (RU)<br>(vi) Geriatrics training (BY) | (i) Decreasing mortality, increasing LEB (BY, RU)<br>(ii) Free medical care (AM, BY, RU, UA)<br>(iii) Annual medical examinations (BY)<br>(iv) Geriatrics training (BY, UA)<br>(v) Healthy life styles in media (BY) and education (UA)<br>(vi) The National Program for Healthy Lifestyle Promotion 2007–2015 (MD)<br>(vii) Preventing disability (MD) |
| | Making transport more accessible | (i) Accessible and affordable transportation (AM, AZ, MD, RU) | (i) Accessible and affordable transportation (RU, UA) |
| | Making the environment more age friendly | (i) Safe living environment (AM; BY)<br>(ii) Barrier free environment (BY) | (i) Social dwellings/housing (AM, MD)<br>(ii) Barrier free environment (BY)<br>(iii) Housing subsidies (UA) |

Source: [43, 44]. For country abbreviations, see the footnote of Table 4.

support to older job seekers, and coordinating the work of employment services and social services.

In 2007, the Republic of Moldova adopted *The National Strategy on Employment Policies in the Republic of Moldova for the Period 2006–2020*. The medium term measures (2006–2010) aimed at reducing the early retirement; introducing incentives for flexible employment; promoting professional training programmes for preretirees; and organizing annual job market events for persons at pre-retirement age. The long-term measures (2011–2020) are focused on promoting policies for improving the work conditions, introducing incentives for a longer working career and preventing age discrimination in employment [49].

*5.2. Social Participation.* To facilitate social participation and promote active ageing in a wider perspective, measures are proposed in many CIS countries for the purpose of *encouraging voluntary activities*, *supporting informal carers*, and *recognizing contribution* of older persons to the various spheres of societal life.

Integration and participation in societal life was noted as a priority area in 2007 by five countries, and in 2012, by three countries (see Table 4). Again, as with other priority areas, the content and range of policy measures, either undertaken or planned, have varied between the countries. For instance, Azerbaijan, in its *State Programme to Increase Social Protection of Older Citizens* that was approved by the President in 2006, proclaimed that ensuring participation of older persons in socioeconomic and political life of society is among the major tasks of the *State Programme*. In the Republic of Moldova, the very limited public resources have been allocated for the cultural projects in various regions, and particularly in rural areas.

The Republic of Moldova has promoted intergenerational volunteering. As an example of bottom-up initiatives in the CIS countries, one worth-mentioning measure is the establishment in Belarus of self-help and mutual help groups for the reintegration of socially vulnerable older persons, particularly in small towns and villages. Similar initiatives exist in the Republic of Moldova and Ukraine and might be considered as an adjustment to the lack of access to or simply absence of appropriate governmental programmes.

Informal care givers are supported through the monthly allowances for family carers (in Belarus, the Russian Federation, and Ukraine) and also their inclusion for credits into the state pension schemes (Belarus, Ukraine). Training programmes for care volunteers and family carers are offered in Belarus, the Russian Federation, and Ukraine.

Governmental and nongovernmental programmes promoting positive images of older persons are reported by Armenia, Belarus, and the Russian Federation.

*5.3. Policies Promoting Independent Living.* Policies to promote independent living of older people include actions of promoting life-course preventive approach in health care; making the environment more age friendly; making transport more accessible for frail older persons.

As noted above, issues of health and medical care have been among the top priorities for policy actions on ageing in the CIS countries (Table 4). The policy measures in the area of health have ranged from improving the delivery of services to the measures of preventing old age associated diseases through promoting the healthy and active life styles.

Many CIS countries see the task of increasing the life expectancy and lowering the mortality rates as a matter of their national security. In Belarus, for instance, the goals of decreasing the mortality and increasing the life expectancy at birth are included in the *National Programme on Demographic Security of the Republic of Belarus for 2011–2015*. The *Concept of the Long-Term (2008–2025) Socio-Economic Development of the Russian Federation* adopted in 2006, among its three goals, seeks to increase the life expectancy at birth to 70 years by 2015, and to 75 years by 2025. The latter figure, however, is considered unrealistic by some experts [52]. The *Programme of Economic Reforms in Ukraine for 2010–2014*, envisages measures, *inter alia*, for promoting the extension of life expectancy and, particularly, the period of active longevity, life duration, and improving the quality of life in the advanced ages.

It should be noted that practically all the CIS countries, as a legacy of the Soviet Union welfare state, possess the elements of a free health care system. Within such a system older persons in Belarus, for example, receive free annual medical examinations, and, in Armenia, free services in policlinics. Many CIS countries (Armenia, Azerbaijan, the Russian Federation, and Ukraine) have maintained or introduced new programmes for subsidizing the medicines for persons with disabilities and other categories of citizens. However, as mentioned above, severe under-funding of public health care systems forces private out-of-pocket spending, particularly in low income CIS countries [22].

Specialized geriatric services are offered only in a few CIS countries, namely, Belarus, the Republic of Moldova, the Russian Federation, and Ukraine, and geriatrics training is being provided in Belarus and Ukraine.

The *promotion of healthy life styles* has been undertaken through media campaigns (Belarus) and educational programmes (Ukraine). In Belarus, the *State Programme for Promoting Healthy Life Style* had been implemented during the periods 2002–2006 and 2007–2010, the *State Programme for Ensuring Sanitary and Epidemiological Well-Being*. In the Republic of Moldova, the availability of various programmes on raising awareness for a healthy life style has also been reported.

The issue of accessible and affordable transportation has been among the policy concerns and actions observed in Armenia, Azerbaijan, the Republic of Moldova, the Russian Federation, and Ukraine. In the Russian Federation and Ukraine, the corresponding measures have included financial subsidies towards providing free or discounted access to public transportation for certain categories of older persons, such as persons with disabilities and war veterans.

The barrier-free environment is an established policy area in Belarus, which has the *State Programme on Barrier-free Environment*. The safe living environment is also on the policy agenda in Armenia. The issue of affordable housing has been addressed through the state subsidies (Ukraine) and provision of social dwellings (Armenia, the Republic

of Moldova). In Armenia, for instance, social dwellings for homeless lonely older persons have been developed since 2008.

## 6. Conclusions

CIS countries are undoubtedly a unique group of states, whose commonality and association is based primarily on their joint recent history. While they share the legacy of the Soviet past, they are different in many aspects: in their geographic, political, economic, social, and demographic spheres of life. In spite of all the differences, the legacy of the soviet past prevails in the structure and functioning of the CIS states, including the policy responses to various challenges. Population ageing challenges are among the most demanding, and by many countries in the region are considered a matter of social and economic stability. The linking issues of high mortality and migration are the top policy priorities, in practically all the CIS countries.

Population ageing has been recognized as a matter of major concern by the majority of the CIS countries. In spite of this major-concern status assigned to population ageing by the governments of the respective countries, a comprehensive national strategy on ageing in these countries is a rare phenomenon. The existing sectoral policy and programmes on ageing are often a legacy of the pretransition era with modifications made on *ad hoc* basis. In some cases, more comprehensive and radical reforms were put aside owing to political uncertainties, lack of societal consensus and also financial instability. In some countries, the continuity of policy interventions has also been disrupted owing to the unfulfilled process of political transition and associated frequent government reshuffles.

Under such circumstances, policy measures of choice could be a consolidated approach aimed at addressing the major challenges and utilizing the major opportunities existing in the CIS countries. Among the major opportunities is the established yet slowly reformed and poorly financed government infrastructure on ageing and mainstreaming of ageing into national development strategies and other fundamental national policy action. Another resource is the growing potential of civil society organizations getting involved in various dimensions of policy action on ageing, not just in advocacy, but also in the service provision and in the policy advice. Equally important are the signs of improving capacity among researchers working on ageing who strive to collaborate at the international level, although additional support is required from the international community in building capacity for evidence-informed policymaking.

Once properly understood in the national terminology, the active ageing policy discourse can potentially become a promising approach in the CIS countries, as it allows them to address the challenges of population and individual ageing in a consolidated way by simultaneously tackling other demanding tasks of transitional societies: reforming the labour market, promoting social integration of older persons and intergenerational cohesion in a society, and addressing the health crisis. The guiding principles and actions identified under the European year for Active Ageing

and Solidarity between Generations 2012 provide the right mix of inspiration and examples of best practices for the CIS countries.

## Acknowledgments

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*Research Article*

# Mobility and Active Ageing in Suburban Environments: Findings from In-Depth Interviews and Person-Based GPS Tracking

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*Background*. Governments face a significant challenge to ensure that community environments meet the mobility needs of an ageing population. Therefore, it is critical to investigate the effect of suburban environments on the choice of transportation and its relation to participation and active ageing. *Objective*. This research explores if and how suburban environments impact older people's mobility and their use of different modes of transport. *Methods*. Data derived from GPS tracking, travel diaries, brief questionnaires, and semistructured interviews were gathered from thirteen people aged from 56 to 87 years, living in low-density suburban environments in Brisbane, Australia. *Results*. The suburban environment influenced the choice of transportation and out-of-home mobility. Both walkability and public transportation (access and usability) impact older people's transportation choices. Impracticality of active and public transportation within suburban environments creates car dependency in older age. *Conclusion*. Suburban environments often create barriers to mobility, which impedes older people's engagement in their wider community and ability to actively age in place. Further research is needed to develop approaches towards age-friendly suburban environments which will encourage older people to remain active and engaged in older age.

## 1. Introduction

ageing is a global phenomenon. By 2051, it is estimated that 28% of the Australian population will be aged 65 years and older, representing a doubling of this older cohort from 2004 [1]. Most of Australia's ageing population (64%) reside in urban areas [2], characterised by a predominance of low-density suburban environments [3]. As most older Australians intend to "age in place" and remain living in their community as they get older [4], urban planners and policymakers are focused on ensuring that the design of the urban environment meets their changing needs. Issues of health, housing, income, and mobility typically dominate policy discussions, with increasing acknowledgment that the quality of life for older people depends on them being able to maintain their participation within the community in preferred out-of-home activities [5]. Thus, this paper specifically investigates if and how characteristics of suburban environments might impact older people's mobility, transport-mode choices, and participation in community activities.

Mobility, succinctly defined as "the fundamental physical capacity to move" [6, page 782], is important for active ageing. The World Health Organization's [7] definition of active ageing identifies participation (alongside health and security) as one of three key contributors to quality of life in older age. Healthy and active living in older age is conceptualised as an outcome of an ageing process that allows equal opportunities and treatment for people at all stages of their life, regardless of their personal characteristics [7, 8]. The community environment should enable everyone to stay active and engaged, regardless of varying needs and capacities. The built environment, which describes all aspects of the environment created and built by humans, has a

central role in facilitating older people's opportunities for health, participation, and security [9]. Critically mobility is often central to enabling older people's participation—particularly when they reside in suburban communities where the characteristics of the built environment and transport infrastructure may either enable or impede their participation in out-of-home activities.

Research has demonstrated that the built environment has an influence on quality of life and mobility, as it facilitates safe, accessible, and affordable services in reasonable travel time [10]. Neighbourhood characteristics such as affluence, better amenities, and facilities also promote higher levels of social activity, although social contact is unrelated [11]. The walkability of neighbourhoods is critical to active ageing, as it inhibits or allows the integration of physical activity into daily routines and fosters interaction with others [12]. Specific neighbourhood characteristics (such as density, greater number of safe street intersections, and green and open spaces) have been found to positively influence walking activity in older age [13]. The use of public transport options is generally found to be difficult in older age because of service design and provision, vehicle accessibility, provision of information, other people, and personal mobility [14]. Older drivers also change the use of their car, due to factors such as retirement, age, and health as well as difficult traffic situations [15] and might therefore also face reduced mobility. However, while there is evidence that the environment sets the context for out-of-home mobility, it remains unclear to what extent the built environment impacts the use of different transport options in older age [16] and thus its effects on older people's capacity for active ageing.

The idea, that community environment affects out-of-home mobility in older age, is based on the assumption that the interplay between the individual's competences and environmental characteristics determines the optimal functioning of the individual [17, 18]. The holistic approach to mobility taken by Webber et al. [19] demonstrates the complex relationship between between individual determinants (such as cognitive, physical, psychosocial, and financial), cultural determinants (gender, culture and biographical influences), and environment determinants of mobility. This mobility model illustrates that diverse life-space environments (such as home, outdoors, neighbourhood, etc.) involve the interaction of mobility determinants at different levels. A number of cross-national European studies have investigated the complex mobility issues of older people in relation to either their urban or rural environment [20, 21]. One study focused on older peoples day to day mobility and the complex interplay of personal resources and the physical and social environment [20]. It was found that health, housing, the environment, and social network resources impact older people's out-of-home mobility [20]. Further, the use of transport options differs between rural and urban environments and between nations. While walking is used most, especially in combination with services, public transportation is used little in rural settings and more in urban settings. Familiarity with an area positively influences out-of-home mobility [20]. Another

study focused on the perspective of older people and experts on the current mobility situation in older age [21]. Mobility was found to be critical to fundamental needs of daily life, walking, and leisure activities. Mobility is also important to maintain a positive self-perception, especially when it allows participation in caring activities (childcare, care for other people), with being mobile also adding to quality of life itself [21].

In America, over half of older people live in highly car-dependent suburban environments [22], which is mainly related to the non-availability of alternative transport options and impractical walking conditions [23]. Suburban environments create mobility constraints and difficulties in older age and adaption processes of mobility practices were found to be important to avoid having to move somewhere else [24]. The reality is that driving is essential within suburban environments for active daily life and allowing independent and autonomous living [25]. In order to stay in their suburban environment, older people change their daily routines (unconsciously) and with this their travel behaviour on an ongoing basis [26]. This is critical as these adaption strategies often result in the reduction or fragmentation of space used within the community, which might lead to a significant loss of autonomy [25].

As the majority of older Australians live in suburban environments, it is critical for policy makers and urban planners to identify strategies to enhance out-of-home mobility in those environments. While the literature identifies the built environment as an influence on travel behaviour, the direct effect of suburban environments on older people's travel behaviour, and consequently their mobility remains rather unclear. Thus, this current study explores how low-density suburban environments impact the use of different transport options in older age and discusses its consequences for active ageing.

## 2. Methods

This research uses a qualitative research design. Investigating the link between active ageing, mobility, transport options, and the built environment is a complex undertaking. Therefore, a range of instruments was used to collect data for an in-depth analysis exploring the effect of the community environment on older people's travel behaviour. This paper focuses specifically on mobility aspects, with the data for the cases ($n = 13$) including sociodemographic characteristics, residential location and character, available travel options, preferred or non-preferred built environment, and real-time measurement of travel behaviour. Ethical approval for this research was given by the Queensland University of Technology (QUT) Human Research Ethics Committee.

*2.1. Sample.* This study focuses on the experiences and travel behaviour of older Australians residing in 11 different low-density suburbs across Brisbane (the state capital of Queensland), with a range of 5.05 to 27.74 people per hectare [27]. These suburbs are typified as residential areas with lone standing family homes with yards, and pockets

of business areas with shopping centres or strips with shops and facilities. The data used for this study were collected as part of a larger project exploring active ageing and liveability in rural, regional, suburban, and urban locations. This research focuses on data concerning older people residing in low-density suburban environments. Industry partners cooperated by recruiting participants aged 55 years and older. As one purpose of the study was to investigate the differing perceptions and experiences of older people of various ages, the age of the participants for this study ranges from 57 to 87 years. Table 1 illustrates participants sociodemographic characteristics, with the majority retired (only one was still working part time) and females on average were 7.75 years younger than males.

### 2.2. Data Collection.

Participants' data were gathered in 2010 in two phases (see Figure 1), as part of a larger project with a focus on ageing and liveability in rural, regional and urban locations.

Firstly, a travel diary (including a brief questionnaire) was handed out in combination with a GPS tracking device [28], to collect data on travel behaviour and out-of-home activities, over seven consecutive days. Secondly, semi-structured interviews were conducted. Those were aided by individual Google Earth maps [29], showing activities and transport options used during the week of tracking (see Figure 2). The maps were created prior to the interviews by using the travel diaries and the GPS data. The use of transport options was coded in different colours. The main focus of the interviews was to explore how participants conceptualised the liveability of their respective communities. All interviews were audio-recorded. A brief questionnaire in the travel diary assessed key sociodemographic characteristics (see Table 1) and participants' reflections about their activities. External sources were used to identify residential characteristics, such as distance to CBD [30], population density [27], and available transport within a five to seven minutes walk [31].

### 2.2.1. Measures: Residential Location and Character and Available Travel Options.

Distance to CBD and public transport was represented in kilometres and population density as people per hectare. Participants were asked during their respective interviews what they would do if they could not drive anymore or if they could not maintain the way they currently move around when travelling outside of home. Five categories were developed from participants' responses to this question, namely: "would need to relocate elsewhere"; "could stay with help from family"; "could stay by changing current transport mode"; "could stay by using local services"; "not thought about."

### 2.2.2. Measures: Preferred or Non-Preferred Aspects of the Built Environment.

In the questionnaire, participants were asked questions about their local community: why they live here, whether they liked it, and how long they thought they could live there. A thematic analysis of the interview transcripts explored in depth participants' preferred and non-preferred aspects of their community, focussing on built environment characteristics, transport options, land use, and design (see Table 2).

### 2.2.3. Measures: Travel Behaviour.

Data on participants' travel behaviour was collected using GPS tracking and a questionnaire (see Table 3) that asked participants "How do you get around?" (Options: "*I walk*"; "*I use a bicycle*"; "*I drive myself* with a: "car", "motorcycle", "motored wheelchair", "mobility scooter"; "*someone else drives me*": "my partner," "my children/grandchildren," "community members," "social or senior services"; "*I use public transport*": "bus", "train", "taxi", "ferry"; "*I would like to use public transport but*": "It is not available in our community", "It does not go where I need it to go", "It is too far away from my home", "It is too expensive", "I do not feel safe", "It is too hard to use"). The maps, the travel diary, and interview responses were also used to code the GPS data. Two main categories emerged: travel by transportation (by car as driver, by car as passenger, bus, train, walking, cycling, and ferry) and out-of-home activities, which were classified as daily life activities (e.g., shopping, health) and social activities (e.g., meeting friends, volunteering). This paper focuses on the data about travel by transportation.

### 2.3. Data Analysis.

Researchers assigned each participant a unique code number. Each individual's GPS data were analysed to determine the distance travelled per mode of transport used (in kilometres) and the destinations reached (representing activities). All interview audiotapes were transcribed verbatim. The text of the transcripts was manually coded for relevance to preferred and non-preferred aspects of the built environment and its components (transport options land use, and design). All measures were grouped by participant and the amount of car use for transportation (100% car, 90–99% car, 75–77% car, and 0% car). These groups were compared to each other in order to assess whether demographic characteristics, residential location and character, as well as preferred and non-preferred features of the built environment influence travel behaviour.

## 3. Results

### 3.1. Demographic Characteristics, Residential Location and Character, and Travel Options.

Multiple factors, such as socio-demographic characteristics, residential location and character and available travel options, might influence mobility (see Table 1). In this research, the car was the predominant transport choice; five older people drove by car for all trips made during the monitored week and four used the car for between 90–99% of their transportation. People within these two groups were, on average, older than people who drove 75–77% of the distance, or not at all. Of the thirteen participants, seven were married and one widowed, all eight travelled 90–99% or 100% by car.

The character and location of participants' residential areas varied considerably (see Table 1). Seven participants lived less than ten kilometres and six lived ten to twenty

TABLE 1: Demographic characteristics, residential character, and location.

| | Participant car usage (percentage of distance travelled) | | | | | | | | | | | | |
| | 100% | | | | | | 90–99% | | | 75–77% | | 0% | |
| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
| Demographics | | | | | | | | | | | | | |
| Age | 65 | 71 | 75 | 80 | 84 | 63 | 63 | 80 | 87 | 57 | 72 | 67 | 69 |
| Gender | | | | | | | | | | | | | |
|   Male | | x | x | x | x | | | x | | | x | x | x |
|   Female | x | | | | | x | x | | x | x | | | |
| Marital status | | | | | | | | | | | | | |
|   Married | | x | x | x | x | x | x | x | | | | | |
|   Widowed | | | | | | | | | x | | | | |
|   Not married | | | | | | | | | | x | x | | |
|   Living alone | x | | | | | | | | | | | | x |
|   Living with friends/other people | | | | | | | | | | | | x | |
| Paid work | | | | | | | | | | | | | |
|   None | x | x | x | x | | x | x | x | x | x | x | | x |
|   Part-time | | | | | | | | | | | | x | |
| Annual income | | | | | | | | | | | | | |
|   Under $20k | | | | | x | | | | | x | x | x | |
|   $20k–$40k | x | x | | x | | | | | | | | | x |
|   $40k–$50k | | | | | | x | x | | | | | | |
|   $\geq$$70K–$100k | | | x | | | | | x | | | x | | |
| Residential character and location | | | | | | | | | | | | | |
| Approx distance to CBD (in kms) | 17.0 | 19.0 | 8.0 | 20.0 | 15.0 | 4.0 | 9.0 | 6.0 | 10.0 | 9.0 | 6.0 | 20.0 | 4.0 |
| Density (people per hectare) | 13.7 | 5.1 | 21.1 | 7.1 | 7.8 | 25.7 | 18.2 | 27.7 | 13.9 | 21.4 | 27.7 | 17.3 | 25.7 |
| Available transport | | | | | | | | | | | | | |
|   Car | x | x | x | x | x | x | x | x | | | x | | x |
|   Bus | x | x | x | | x | x | x | x | x | x | x | x | x |
| Service frequency | | | | | | | | | | | | | |
|   Quarter-hourly | | | x | | | | x | x | | | x | | |
|   Half-hourly | | | | | | x | x | | x | | | x | x |
|   Hourly | x | x | x | | x | x | x | | x | x | | x | x |
|   Peak time more frequent | x | | x | | | x | | | x | x | | x | x |
| Suitability of location for ageing in place | | | | | | | | | | | | | |
|   Would need to relocate | | x | x | x | | | x | x | | | | | |
|   Could stay with help from family | | | | | x | | | | x | | | | |
|   Could stay by changing current transport mode | x | | | | | x | | | | | | x | x |
|   Could stay by using local services | x | | | | | | | | | | | | |
|   Not thought about | | | | | | | | | | x | | | |

kilometres from the CBD. Most people had access to a car and public transport within a five to seven minute walk. However, the frequency of available transportation options varied widely. People living closer to the CBD tended to have a more frequent bus service than those living further away. While only four participants had access to quarter-hourly services (three of these lived within six kilometres of the CBD), nine participants had access to only half-hourly or less frequent bus services. Services were more frequent during peak hours for three participants in this group. The frequency of services was generally lower for people who drove 100% of kilometres by car.

Participants' perceptions of the suitability of their environment to allow them to age in their present location also varied across the sample. Out of the nine participants who drove 90–99% or 100% by car, five stated that they would have to relocate if their physical mobility declined. In the whole sample of thirteen participants four said that they would need to change their current transportation mode, while two said they could remain in their current location with the help of family and friends.

*3.2. Preferred and Non-Preferred Features of the Built Environment.* Features of the built environment, preferred and
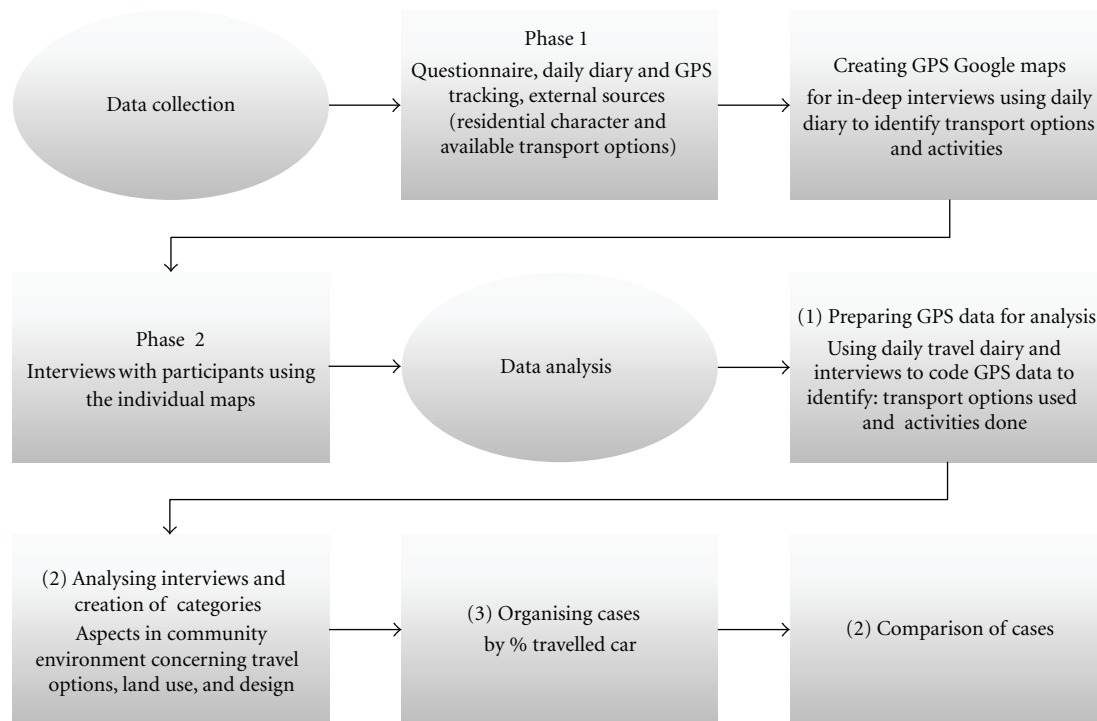
Figure 1: Data collection and analysis.
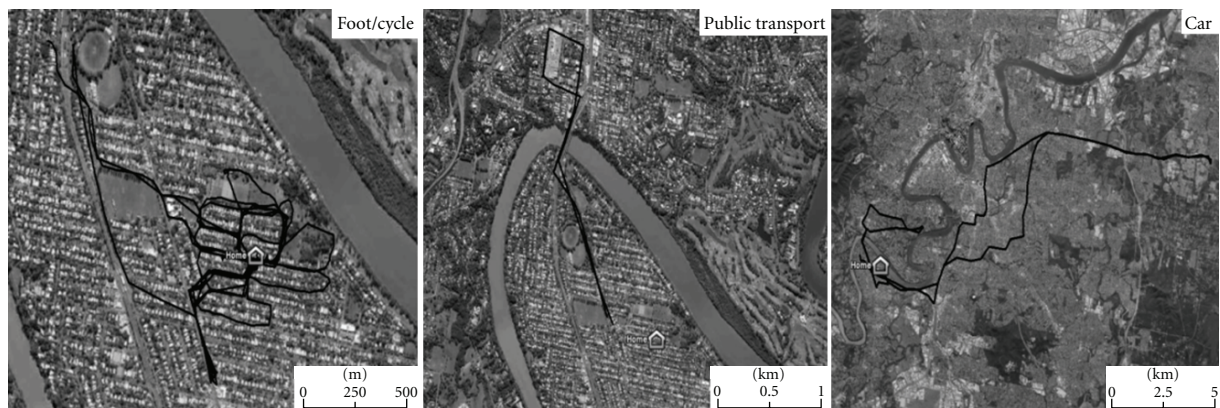


Figure 2: Maps showing use of transportation by one participant.

non-preferred, also have an impact on liveability and travel behaviour (see Table 2). Participants described proximity to family and friends being significant to where they lived: "*But that is an important part of where we live, is having reasonable access to your kids.*" *(P12).* Proximity to shops and services was also most commonly cited reasons for living within the current environment: "*We always said as we got older we would be going back to the city, where you have got the services.*" *(P6)*

Most participants said they would like to live in their community as long as they were able to live independently. All those participants who stated in the interview that they would have to move away from their current neighbourhood

when their physical mobility declined used the car for 90–99% or 100% of their travel. One participant highlighted at interview: "*When our mobility slows down to a point where perhaps we can't drive, that might be just about the time [to move].*" *(P2)*

Most people either "loved" their community or found it "ok" to live there, although one participant stated he hated where he lived (see Table 2). Participants who drove everywhere by car were more likely to state that where they live is "ok" while most participants who used the car for 90–99% of all distance travelled stated that they loved where they lived. The main preferred aspects of the built environment by the participants included proximity, ambience, and access

TABLE 2: Preferred and Non-preferred features of built environment.

| | Participant car usage (percentage of distance travelled) | | | | | | | | | | | | |
| | 100% | | | | | | 90–99% | | | 75–77% | | 0% | |
| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reasons for living in the community** | | | | | | | | | | | | | |
| Affordability | | x | x | x | | x | | x | | x | | x | |
| Proximity | x | | | x | x | x | x | x | x | | | | |
| Liking | | x | x | | | | x | x | x | | | | x |
| Safety | | x | | | | | x | x | x | | | | |
| Hometown | | | | | | | | | | | x | | |
| Community member | | | x | | | | | | x | | | | |
| **Staying in community** | | | | | | | | | | | | | |
| As long as I am independent | x | x | | x | x | | x | x | | x | x | | |
| As long as I live | | | | | | | x | | x | | | | x |
| Until a set timeframe | | | x | | | | | | | | | | |
| **Liking of community** | | | | | | | | | | | | | |
| Love it | | | | | x | x | | x | x | x | | | x |
| It is ok | x | x | x | x | | | x | | | | x | | |
| Hate it | | | | | | | | | | | | x | |
| **Preferred features of built environment** | | | | | | | | | | | | | |
| Proximity | | x | | | | | x | | x | x | x | | x |
| Ambience | x | | | x | | | x | | | | x | | x |
| Wide streets | | x | | | | | | | | | | | |
| Access to public transport | | x | x | | | | x | | x | | | | |
| Walkability | | x | | | | | | x | | | | | |
| **Non-preferred features in built environment** | | | | | | | | | | | | | |
| Lack of public green space | | | | | | | x | | | | | | |
| Density | | x | x | | | | | x | | x | | | |
| Bikeability | | x | | | | | | | | x | | x | |
| Walkability | x | | | | | x | x | x | | | | | x |
| Access public transport | x | | | x | x | | x | x | | | | | |
| Information public transport | | | | | | | | | | | | | x |
| Crowded public transport | | | | | | | | | | | | | x |
| Design public transport | | | | x | | | | | | | | | |

to public transport. Statements at interview related to these factors include: "*So it's all sort of within reach and it's nice.*" *(P10)* and "*You can get a bus anywhere over there.*" *(P9)*

However, most of the non-preferred features within their current environments were related to transportation (access to public transport, bikeability, and walkability). Safety was a main issue that deterred participants from using active transportation, with participants describing how limited sidewalks and the speed of pedestrian lights limited their mobility: "*People can't actually step off the road with safe access—on both sides of the road in some sections.*" *(P7)* and "*There are lights on the corner with a pedestrian crossing. I tried to get across as fast as I can and I can't get across in one change of the lights.*" *(P8)* Brisbane's hilly environment and the lack of well-maintained footpaths or bikeways were also perceived as key barriers to active commuting within

the community. Participants explained how "*I would do a lot more walking if I could walk uphill and downhill.*" *(P6)*, "*To get on the bikeways, you've still got to ride on roads.*" *(P3)* and "*You might see some scrapings along on the footpath and people could trip up.*" *(P13)*

Access to public transport was a topic raised mainly by people who drove the majority (90–100%) of their total travel distance. Some of these participants reported having good public transport services within their environment, describing how "*We are quite fortunate in that the bus goes past us either way, almost on a half-hourly basis.*" *(P2)* Within the same group, however, there were also participants who stated that public transport was not accessible where they lived: "*You can see why I push for a bus three/four times a week. There will come a time where I cannot drive anymore. How do I get to the shopping centre?*" *(P5)*

TABLE 3: Travel behaviour and daily average distance travelled by mode of transport.

| | Participant car usage (percentage of distance travelled) | | | | | | | | | | | | |
| | 100% | | | | | | 90–99% | | | 75–77% | | 0% | |
| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
| Travel behaviour | | | | | | | | | | | | | |
| Active transport | | | | | | | | | | | | | |
| Walk | | x | x | x | | x | | x | x | x | x | | x |
| Bike | | | x | | | | | | | x | | | |
| Car | | | | | | | | | | | | | |
| Drive myself | x | x | x | x | x | x | x | x | | | x | | x |
| Someone else drives | x | | | x | | | | x | x | | | | |
| Public Transport | | | | | | | | | | | | | |
| Bus | x | | x | x | | x | x | | x | x | x | x | |
| Train | x | x | | | | | | | | | | | |
| Ferry | | | | | | | | | x | | | | |
| Reasons not to use public transport | | | | | | | | | | | | | |
| Unavailability of routes to preferred destinations | x | | | | | | x | x | | | | | |
| Transit depot too far from home | | | x | x | x | | | x | | | | | |
| Overcrowded and infrequent | | | | | | | | | | | | | x |
| Daily average distance travelled per mode of transport (kilometres) | | | | | | | | | | | | | |
| Active transport | | | | | | | | | | | | | |
| Walk | | | | | | 0.1 | 0.2 | 0.3 | 0.2 | 0.6 | 0.2 | | 6.3 |
| Bike | | | | | | | | | | 1.0 | | 24.8 | |
| Car | | | | | | | | | | | | | |
| Drove myself | 35.4 | 33.7 | 66.8 | 29.4 | 16.1 | 24.1 | 18.4 | 6,8 | | | 9.5 | | |
| Someone else drove | 1.9 | 5.2 | | 1.0 | | | | 1.0 | 13.6 | 8.7 | | | |
| Unspecified | | 2.2 | | 3.3 | | | | | | | | | |
| Public transport | | | | | | | | | | | | | |
| Bus | | | | | | | 1.2 | | 0.8 | 0.8 | 0.8 | | |
| Train | | | | | | | | | | | | 36.3 | |
| Ferry | | | | | | | | | | | 1.2 | 0.1 | |
| Taxi | | | | | | | | | | | 1.0 | | |
| Recreational | | | | | | | | | | | | | |
| Walk | | 0.4 | 0.1 | | | | | | | 1.8 | 3.7 | | |
| Bike | | | 2.8 | | | | | | | | | | |

While affordability was one reason participants gave for living in their current environment, across all groups, proximity (to services, the city, friends and family) was the main reason given by older residents who drove for the majority (more than 90%) of the distance that they travelled during the monitored week.

*3.3. Modes of Transport Used and Distance Travelled for out-of-Home Activities.* The transportation system and built environmental features also had an impact on travel behaviour (see Table 3). Most participants stated that they would use the car, walk, and take the bus. Only a small number within the sample ever used a bicycle, train, or ferry. However, about half of participants reported that they would like to take public transport but that it was either too far from home or would not take them where they wished to go (or both in the case of one participant, see Table 3). One person identified busses as being overcrowded and services being too infrequent.

While the questionnaire data suggested that people use different forms of transport, the GPS tracking over the monitored week shows that the car was used for the majority of distance travelled by all but two participants. These two people did not drive at all, while the other participants travelled by car for between 75% and 100% of all distance between home and their various destinations. Participants, for whom the car accounted for 100% of the distance travelled over seven days, had travelled on average 27.3 kilometres further than the rest of the retired participants.

Engagement in active transportation modes such as walking and biking varied widely within the sample. Eight people engaged in active transportation. Five of them walked 1–4% of their total distances, one walked 5% and biked 8% of the total distance tracked, one walked everywhere and another one was working part-time and combined train (60% of kilometres travelled) and bike (40% of kilometres travelled), mostly for work-related travel. This particular participant travelled by bike as many kilometres as other participants did by car and overall, travelled the second greatest distance of the entire sample. The participant who walked 100% stated that he would usually drive a car himself but could not drive temporarily due to health issues.

The GPS data showed that only five of the thirteen participants used public transport and that the extent of usage varied. Distance to CBD and frequency of services seem to influence its usage. Public transport was used by three participants, living 9 to 10 kilometres away from CBD, for 5% to 6% of the distance travelled. Only one of them had a quarter-hourly bus service available. Another participant, with a quarter-hourly bus service available, lived closer to the CBD and was using public transport for up to 18% of her travel.

Trips were generally made between 7 am and 9 pm. Only four people engaged in recreational walking or cycling activities during the tracked week.

## 4. Discussion

This research provides some significant insights into the impact of the suburban environment on the use of different transport options in older age. The qualitative study has provided a snapshot of travel behaviour of thirteen older people, gained by a combination of qualitative interviews, travel diaries, and unique person-based GPS observation of a week's travel. Combined, the findings highlight how suburban environments in Brisbane influence older people's travel behaviour.

Three key findings warrant specific attention. Firstly, low-density suburban environments are impractical for walking or biking for older people. Factors such as lack of footpaths or bikeways and the hilly environment create difficulties for older people wanting to use these forms of transportation. Consistent with previous research (e.g., [12]), our findings also suggest that suburban designs discourage older people from incorporating physical activity into their daily lives. This raises two critical aspects in relation to active ageing: the importance for physical activity in older age for health and the engagement in social encounters within the community [12]. People who walk or bike might be more engaged in their community, because the act of walking within the local community helps to foster an appreciation of it [10, 12]. This finding lends support for Alley et al. [10] proposition that the creation of safe walking and biking environments has the capacity to enhance quality of life in older age not only by encouraging physical activity but by also facilitating engagement with and appreciation of one's local community.

Secondly, low-density suburban environments often tend to make the use of public transportation impractical. Our findings show that most participants (across eleven suburbs) had access to public transport within a walking time of 5 to 7 minutes, but only a small number used public transport. Even though the distance between home and bus stops might be walkable, the quality of the pedestrian infrastructure might be discouraging older people from using public transport [14]. If the street environment does not support walking to and from public transport, it is likely to impede its use by older people. Infrequent or low frequency scheduling might also be an impact factor on the non-use by older people [14]. Our findings suggest that policy makers and transportation planners promoting active ageing might want to increase the use of public transportation by older people. This is critical as public transportation allows car-independent transportation within the wider community. Strategies need to be developed to encourage the use of public transportation by provision of a reasonable frequency of transportation throughout the day and a pedestrian friendly infrastructure at all stages of the journey between home, transit nodes and destinations as well.

Thirdly, this research highlights that low-density environments are likely to create car dependency in older age. This is not a problem as long as the older people can drive. But, the car is not a sustainable transport option [32]—as our older participants themselves acknowledged. However, it is unlikely that older people begin to use public transport when they retire, especially if they never used public transport before [33]. The results of this study show that suburban environments put ageing in place at risk if driving is not longer an option. Interestingly, Lord et al. [26] found that older people change their lifestyle in order to remain in their communities as they age. Consequently, this adaption process also results in a change of travel behaviour and the reduction and fragmentation of the action space within the community [34]. This has implications for active ageing, as the reduced mobility could lead to reduced participation within the community. Retrofitting neighbourhoods is, in combination with a range of policy and program development, a possible way to reduce mobility lost for older people who are ageing in place [33]. While on one hand the aim should be to make suburban environments less car-dependent, it also would mean keeping older people driving safely as long as possible.

Finally, this is a qualitative study with a small sample size conducted in Brisbane, Australia, which necessarily precludes its findings being generalised to older people living in other suburban contexts. It needs also to be acknowledged that the combination of Brisbane's subtropical climate and its hilly topography might make the use of active and public transportation more difficult in certain locations and at certain times of the year (e.g., the humidity and storms at heat of summer). The way GPS data was prepared and analysed in this research is likely to be infeasible for use among large samples. Still, the data collection from different sources allowed the researchers to capture the effect suburban environments

can have on the use of transport options in older age. Given the nature of the findings, they are also likely to be relevant to suburban environments elsewhere. Of course, much more research (with larger, more diverse samples in different contexts) is needed to better understand the design characteristics of "age-friendly" environments and the relationship between mobility and activity within the suburban environment.

## 5. Conclusion

Active ageing is a concept that encompasses preventive health, social participation, and overall wellbeing during the ageing process. Our findings suggest that environments that support active transportation modes not only allow older people opportunities for maximising their physical activity but also their use of public transportation and, in turn, their engagement within the wider community. Governments need to prioritise forms of urban development that create the conditions whereby older people are able to walk and bike safely and gain easy access to public transport. However, as older people might potentially be physically able to drive a car longer than they are able to use active and public transportation, the environment also needs to facilitate safe transportation by car in older age. Given that Australia's population is ageing, and that out-of-home mobility is critical to active ageing within the community, there is an urgent need for further attention to be paid to the impact of built environment characteristics and available transport options to encourage older people's mobility. This is critical for policymakers and planners to be better informed about the development of tailored strategies that will help ensure that people can remain active and engaged within the community as they age.

## Acknowledgments

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*Review Article*

# The Right to Move: A Multidisciplinary Lifespan Conceptual Framework

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This paper addresses the health problems and opportunities that society will face in 2030. We propose a proactive model to combat the trend towards declining levels of physical activity and increasing obesity. The model emphasizes the need to increase physical activity among individuals of all ages. We focus on the right to move and the benefits of physical activity. The paper introduces a seven-level model that includes cells, creature (individual), clan (family), community, corporation, country, and culture. At each level the model delineates how increased or decreased physical activity influences health and well-being across the life span. It emphasizes the importance of combining multiple disciplines and corporate partners to produce a multifaceted cost-effective program that increases physical activity at all levels. The goal of this paper is to recognize exercise as a powerful, low-cost solution with positive benefits to cognitive, emotional, and physical health. Further, the model proposes that people of all ages should incorporate the "right to move" into their life style, thereby maximizing the potential to maintain health and well-being in a cost-effective, optimally influential manner.

## 1. Introduction

*Statement of the Problem.* The United States and much of the developed world is benefiting from increased longevity [1]. People are living longer. For the most part this longevity was, at least originally, accompanied by improvements in health and well being [1]. However, recent evidence clearly indicates a reduction in health and increases in chronic illnesses [2], many of which are exacerbated by, if not caused by, obesity, functional impairments, and disabilities [3–6]. The

repercussions of these developments are significant in terms of an individual's quality of life [7], increased health care costs [2], and losses in productivity of the individual [8] and society [9]. Changing, that is, increasing, physical activity levels is very likely the most cost-effective and impressively effective intervention possible. Exercise is a powerful, low-cost solution with positive benefits demonstrated to effect cognitive, emotional, and physical health in people of all ages. However, rates of exercise have been declining over time [10]. As is evident, exercise is only effective to the extent that people actually do it.

*Trends in Physical Activity: A Dilemma with Health and Economic Consequences.* For several decades, governments and health departments around the world have embraced recommendations for "active aging" and the importance of physical activity at all ages for health and well-being [12]. Indeed, the US Department of Health and Human Services established goals in 2000 identifying physical activity as a leading health indicator and establishing goals to improve levels of activity by 2010 [13]. The Healthy People report suggested, for example, that by 2010, at least 25% of adults should report that trips of less than 1 mile were made by walking and that 30% of adults engaged in at least 30-minutes of moderate physical activity five days a week. Some may be astonished by these relatively low expectations, especially given decades of epidemiological and preventative medical research documenting the health benefits of lifestyles associated with regular physical activity and moderate exercise. However, these objectives actually reflect desperate calls to reverse long-term trends of increasing levels of inactivity and sedentary lifestyles that are predicted to have dire consequences on the U.S. economy population health and well being by 2030.

Cohort surveys and longitudinal panel data illustrate the changing trends in participation in *physical activity* (i.e., body movement linked to energy expenditure) and specific participation in planned or structured *exercise activities* done to improve or maintain physical fitness [10]. Respondents are typically asked about frequency of participation in leisure activity, household and yard work activity, occupational activity, self-powered transport (e.g., walking, cycling), and sedentary activity (e.g., sitting). National time-use diary surveys collect detailed information about the time allocated throughout the day to physical activities. Brownson et al. [10] reviewed time trends for these heterogeneous indicators of physical activity and found differential patterns. For example, nationally representative data collected in the Behavioral Risk Factor Surveillance System (BRFSS), revealed slight improvements for both men and women in levels of recommended physical activity (i.e., at least 30-minutes of moderate physical activity five days a week) from under 25% prevalence in 1990 to slightly over 25% prevalence in 2000. However, analyses of the Current Population Survey reveal that on average occupation-related physical activity levels have declined since the 1950s. With each decade, participation in low-activity occupations increases. Furthermore, the means of transport used to travel to work has changed considerably from the 1950s with the large majority driving (88% in 2000) rather than walking or using public transportation. These work-travel trends reflect substantial increases in associated time spent in sedentary activity (sitting) on daily commutes. Time-use surveys also document the increase in time spent in other sedentary activities from 1965 to 1995 (e.g., watching TV, using a computer) and the decrease in time spent doing housework (low level physical activity [14]).

Multiple factors are associated with these differential trends in physical activity. The associations are complex and dependent on the type of activity examined. For example, whereas more highly educated people and those of higher socioeconomic status (SES) tend currently to participate more regularly in planned exercise programs, these same subgroups of the population are also more likely to be employed in sedentary occupations and to drive to work. The extent to which the overall time budget of this socially advantaged group reflects sufficient levels of physical exercise will also depend on work hours, availability in the local environment, job culture, and lifelong preferences for an active lifestyle.

Talbot et al. [15] reported secular trends in leisure-time activities in relatively high SES and health conscious men and women in the Baltimore Longitudinal Study of Aging (BLSA). Overall time spent in leisure-time activity was relatively stable from 1960 to 1990. There was an average 10-min per day increase in high-intensity activity from 1960 to 1970 for men only but subsequent decades showed only marginal increases in this category. In the same period, the BLSA men were on average slightly overweight in all four decades of the longitudinal study and women, although initially not in this category in the 1970s had entered it in the 1990s.

These population trends and the specific findings from a positively-selected group, who in general are expected to favor and adopt preventative health and active aging programs, highlight the extent and breadth of the overall dilemma. Indeed, a recent review of efforts to increase population levels of physical activity concluded that public health and intervention programs shift focus from recommending "moderate" levels of activity (e.g., at least 30 minutes of walking) to recommending change from zero activity to at least a low level [16].

The emerging problem and recommended solution, therefore, is to offset the increasing lack of physical activity by designing effective interventions that will increase the physical activity levels in people of all ages.

*Sustainable Increases in Physical Activity within the U.S. Population.* While there is clearly merit in inducing individuals of all age groups to increase physical activity and to feel personally accountable for their own health status, most experts believe that this is unlikely to gain widespread adoption in the near future. The quickest and clearest path toward universal change will be via organizations that are first responding to issues of their own economic well-being. These organizational platforms can then serve as the basis for individual and familial adoption of necessary lifestyle changes.

Companies and governmental and not-for-profit organizations that employ people are deeply concerned about the ongoing and future health status of both their employees and the families they support. Their concern derives from two perspectives. Healthy employees are clearly on the job more often (presenteeism), are more productive, and contribute to organizational life in ways their less healthy counterparts cannot. Ill family members clearly distract from the potential contributions an employee might make. And, most importantly, whether an organization is self-insured or pays for health care premiums via one of the numerous options, a healthy employee base will significantly moderate the costs associated with providing coverage.

Over the last 5–10 years many employing organizations have begun to collect detailed health status information from each of their employees (BP, LDL, HDL, height, weight, smoking status, alcohol use, exercise activity levels, etc.) through voluntary submissions, often monetarily incented. Some firms have taken steps to make the submission of this type of information mandatory while others have prohibited employees from engaging in certain behaviors that have known deleterious consequences to health. We may see this transition into programs that include all members of the family or household who are covered under the organizational or work place medical plan.

The natural extension of these employing organizations concerned with productivity and health care cost issues is the implementation of programs that increase physical activity on either a voluntary and/or incented basis. Programs that induce and reward the expected behaviors will more quickly lead to the desired outcomes for employees and provide measureable outcomes that can be utilized to further adapt and adjust program parameters and performance. The assumption often made is that once employees are induced to higher levels of health performance, they will influence family members to model their behavior and increase their own health performance. From a marketing perspective, it can be assumed that organizations, industries, or corporations which actively market products and services that incentivize physical activity, will be quickly emulated by all others, especially as positive effects are demonstrated. Clearly influence can be seen, and hopefully understood and galvanized, at different levels from individuals who are personally motivated to improve their own health and perhaps influence their family members to engage in healthier lifestyles, to employers and societies interested in a healthier and more productive workforce. We turn next to a conceptual model designed to synthesize multiple levels of intervention within a single holistic and dynamic framework that has as its goal the increase of physical activity.

*A Conceptual Model to Address Physical Activity Deficit.* As outlined above, there is a vast literature on the importance of exercise for the individual and society, and on how to increase physical activity in people. What is missing from this literature is a larger conceptual framework that examines this problem at multiple levels and spheres of influence, and also examines how each level dynamically influences each other. We propose such a framework as a means to theoretically enrich our understanding of the embeddedness and complexity of physical activity inputs and to practically provide useful intervention points and intersections.

In this paper we draw on an ecological systems framework [17] to address the issue of increased physical activity. In particular, we adapt a recently published ecological model on the childhood obesity epidemic [11] to address the issue of how to increase physical activity across the lifespan (see Figure 1 for our adapted model). Harrison and colleagues [11] present an ecological model that describes causes and potential intervention points of childhood obesity at multiple levels of analysis, ranging from genetic characteristics of the individual to environmental influences including proximal influences such as the immediate family environment to more distal influences such as the child's overarching cultural environments. Their 6-Cs ecological model includes the following spheres or levels.

(1) Cell: this includes biological and genetic predispositions that might influence a child's likelihood of becoming obese. We adapt this level to apply to physical activity predispositions specifically.

(2) Child: this level examines personal, psychological, and behavioral correlates of childhood obesity. We again adapt this level to apply to physical activity and re-label it "Creature" (or individual) to reflect our lifespan developmental approach that extends beyond childhood.

(3) Clan: this includes family characteristics, processes, and dynamics, which we again apply only to physical activity levels.

(4) Community: This level includes individuals' social worlds outside of their homes and may include their place of employment, school, religious organization, and any other community organization.

(5) Country: institutional influences at the state and national levels are included at the country level of analysis, including national economic situations, government exercise guidelines, and media portrayals.

(6) Culture: the culture or society level includes "culture-specific norms, myths, and biases that guide citizens' and policy makers' fundamental assumptions about exercise" [11, page. 51].

Although we rely heavily on Harrison et al.'s [11] model and theorizing, we make three adjustments in the current framework. First, we focus our theorizing exclusively on physical activity specifically, rather than obesity more generally. Next, we see this model as not only applying to children, but to individuals across the entire lifespan. Finally, we add what we believe is an important additional level to this model: Corporations (between the community and country levels; see Figure 1). We do so to specifically advocate for academic-industry partnerships in addressing the important issue of how to increase activity as people age.

It is corporations/organizations that play a dual role in promoting the right to move. They have the resources to act
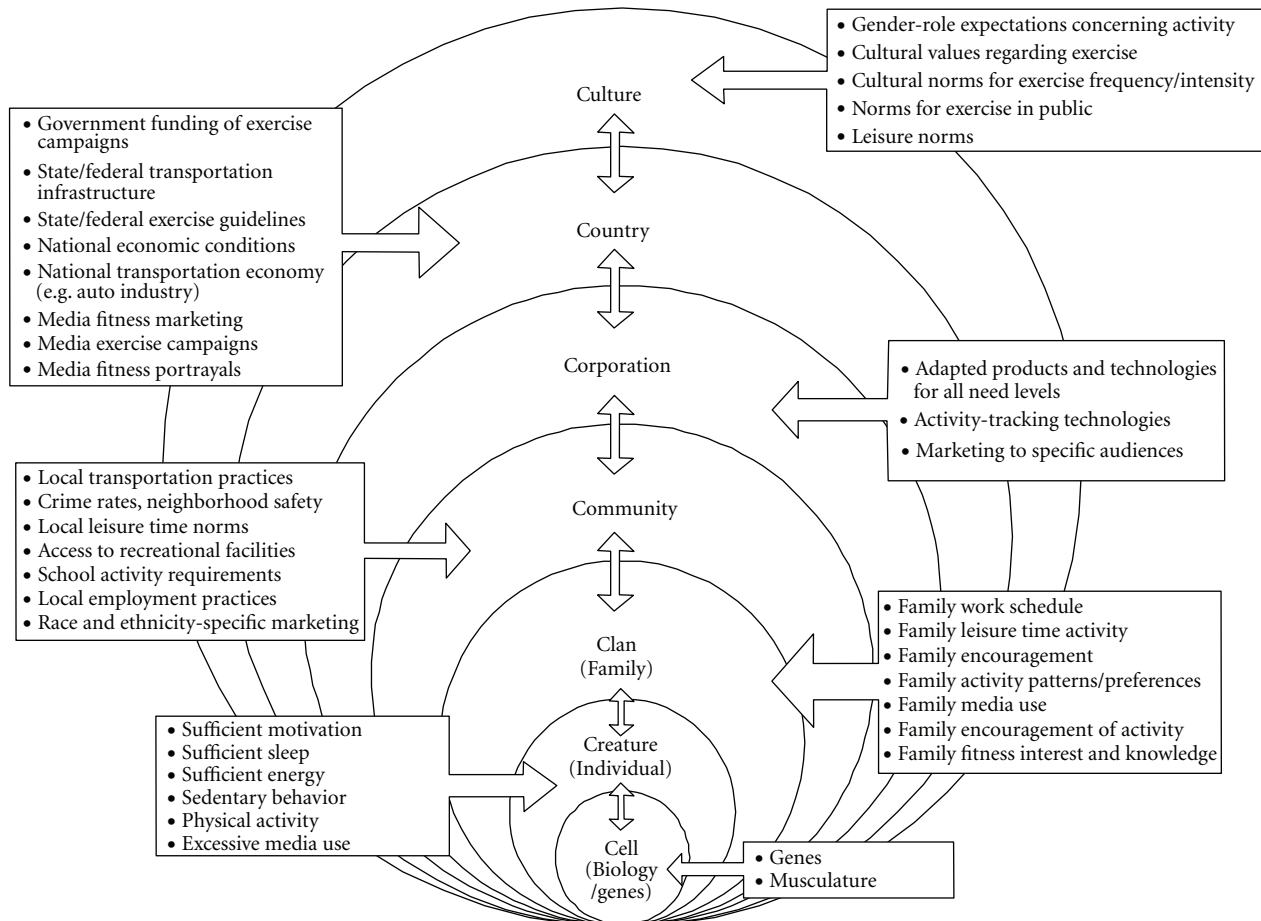
FIGURE 1: The 7-Cs Ecological Model of Physical Activity Across the Lifespan (Adapted from [11]).

as a catalyst for their employees to embrace healthy lifestyles. They can also bring products and services to market that encourage the increased activity levels necessary to reduce obesity and enhance cognitive functioning.

*An Application of the Model: The Society 2030 Interdisciplinary Workgroup.* The above model was developed as part of a unique interdisciplinary workgroup, named Society 2030. The group is focused on meeting the demographic challenges that society will be facing in 2030 and beyond. Its goal is to review available data; outline, propose and/or conduct cutting edge research; and stimulate innovative solutions to problems resulting from the newly emerging society of the future. Society 2030 includes university and industry representatives who, through the cross-fertilization of ideas across disciplines and industries, are constructing a roadmap for the needs of Society 2030—based upon its structure, strengths, weaknesses and opportunities. Healthy life styles across the life span is a central theme and goal of the group.

Below we outline the usefulness of working within a multidisciplinary academic-industry conceptual framework to increase physical activity across the lifespan. Areas of expertise from several members of our workgroup are briefly outlined and placed within the larger conceptual

model to address the physical activity deficit. These sections are intended to demonstrate the potential power of the intersectionality and triangulation that can evolve from the inclusion of such diverse perspectives. We emphasize, in particular, the importance of involving corporate partners in future initiatives to increase active lifestyles. We highlight several (but not all) levels of the conceptual model (Figure 1), and seek to integrate these divergent perspectives into innovative solutions that will effectively increase physical activity among multiple population groups.

## 2. Creature (Individual)

At the individual level an important related effect of physical activity is the cognitive functions that are necessary for successful mobility. Changes that occur with aging (and disease) that affect one's ability to perform motor tasks may have a limiting effect on the physical activity in which an individual can engage. Tasks such as balancing (referred to as postural maintenance) and walking have been shown to require cognitive processes such as attention, response selection, and mental flexibility [18, 19]. The ability to do two things at once, known as dual tasking, is particularly important for activities of daily living, such as walking while

holding groceries, or having a conversation on a cell phone. The consequences of not being able to do two things at once, for example, could lead an individual to focus only on talking on the phone, and put that person at a much higher risk of falling as he/she would not be able to notice and/or react to an upcoming obstacle or a change in the pavement.

As these types of cognitive skills have been shown to become less efficient with age, older adults have more difficulties with dual tasking. Studies have shown that this age group is at higher risk of tripping and falling [20, 21]. In addition, even after controlling for factors such as medical health and physical changes, individuals with documented cognitive impairment have been shown to have more problems with activities such as postural maintenance and ambulation, especially under dual task conditions. This puts them at a much higher falls risk [22–24]. These findings highlight the need for designers of mobility/exercise programs to understand the role of cognitive functioning in mobility. This is an important factor in the design of appropriate interventions that consider the cognitive load associated with any task as well as potential age and disease related cognitive changes that can impact whether an individual can benefit from the program.

Exercise is not only dependent on cognitive abilities, but has also been shown to have a beneficial effect on cognitive functioning in young and old adults. Those who engage in regular physical activity demonstrate better performance on a range of cognitive measures including memory, attention, information processing speed, response time, and tasks such as decision making and problem solving (often referred to as executive functions) [25–28]. These findings have been shown with a variety of exercise programs, with some suggestion that exercise programs that target aerobic efficiency may be somewhat more beneficial to cognitive functioning [29–31]. Exercise related cognitive improvements have also been demonstrated in individuals with definite cognitive impairment. A recent meta-analysis suggested that exercise training can improve cognitive functioning in individuals with Alzheimer's disease and related dementias [32], while there is also some suggestion that exercise may reduce the risk of dementia in older adults. Sumic and colleagues [33] found that older women (in the "oldest-old" age category) who engage in physical activity show an 88% risk reduction of cognitive impairment compared to inactive women.

Although exercise can be a solitary activity, often people plan and engage in such activities with others, thereby increasing their social activities and enhancing the quality of their social relations. The benefits of positive and supportive relationships on health and well-being have been well documented [34]. In particular, Convoys of Social Relations can play an influential role in persuading individuals to improve their health behaviors [35–38]. For example, although there is a longstanding awareness of the positive effects of high quality social relations on health [39], recent more nuanced research has documented that the negative aspects of relationships (i.e., get on nerves; demanding) are associated with greater longevity [40, 41]. This suggests that negative relationship quality although linked to greater

stress, may also play some role in facilitating and sustaining health promoting lifestyle and behavior changes [42].

## 3. Community

There is promising new research that best fits into the Community level of our conceptual framework (Figure 1) and can help address the physical activity deficit in a way that capitalizes on fundamental human needs for social connection and interaction [43]. Researchers have long known that social relationships have positive effects on later health outcomes that are at least as robust as more traditional health risk factors such as smoking, high blood pressure, and even physical activity levels [44]. In fact, a recent meta-analysis finds that those with strong social relationships have a 50% increase in the likelihood of survival, even when taking other risk factors into account [45].

Of particular interest is how regularly structured social activities within communities, such as religious service attendance and volunteering, affect health across the lifespan, especially among older adults, who are known to have relatively high levels of both religious and volunteer participation [46–48]. Much research has found evidence for the physical health benefits of both religious attendance [49, 50] and volunteering [51]. It is believed that both of these types of structured social activities positively influence the physical health of older adults via psychological (e.g., increased meaning and purpose in life) and biological mechanisms (e.g., better stress regulation, improved immune functioning); [49, 51].

At the same time emerging perspectives are providing evidence that one additional way that religious activities and volunteering behaviors could ultimately influence long-term physical health among older adults is by increasing their levels of physical activity. Although no research which we are aware points to increased activity levels as the sole mechanism responsible for explaining health benefits, there are research findings indicating that older adults who are actively religious have higher levels of physical activity than those who are not [52, 53]. Similar outcomes are present among those who are active volunteers. In fact, field experiments that assign older adults to intensive volunteering (e.g., Experience Corps) find significant increases in physical activity levels after the volunteering experiences begin [54, 55]. Taken together, it is not surprising that activities that get people out of the house make them more physically active, but such activities are especially promising because they rely on *social* motivations to get moving rather than the elusive intrinsic desire to simply exercise more.

Importantly, although religious and volunteer participation both fit into the Community level of analysis, these behaviors are most likely to be effectively channeled into increased physical activity to the extent that they are considered at multiple levels of our conceptual model. For example, at the Creature (or individual) level, individuals who are already feeling healthy will be more likely to both attend religious services and volunteer [56, 57]. At the Clan (or family) level, it is more likely that older adults will choose to
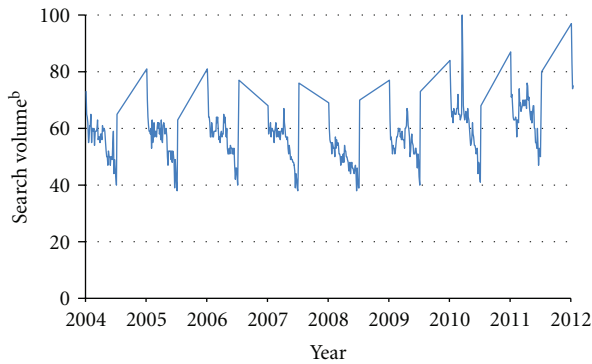
Figure 2: Web Search Interest in "Weight Loss" (2004–present). Source: Google trends.

get out of the house and participate in such activities if they are encouraged, valued, and engaged in by other members of their family. And at the Corporation level, increased religious and volunteer participation is likely to be facilitated by products that support the unique physical needs of an aging population (e.g., comfortable shoes adapted to older people so that they can be on their feet for longer each day).

Another aspect of the Community that can have an impact on physical activity levels is the built or physical elements of the environment. This could include worksite exercise facilities, bike paths, walking trails, gyms, swimming pools, sidewalks, and nice scenery. It is not surprising though that communities with greater financial resources have been documented to have greater access to these types of physical activity encouraging resources [58–60].

## 4. Corporations

Corporations generally develop products and services that respond to market demands. In the future corporations and other organizations should take a more proactive approach that drives the market in the direction of recognizing the right to move and encourages healthier life styles.

Lack of physical activity is resulting in a variety of health challenges, which is certainly driving public and corporate awareness of this important issue. If we examine, for example, through Google search, trends between 2004 and the present, an increasing trend of news coverage for "weight loss" is evident (see Figure 2). In addition, consumer searches for "weight loss" have shown a clear shift starting in 2010 following years of consistent patterns and recorded solid growth for past two years.

The current environment indicates increased public awareness and consumer demand for "weight loss." Nevertheless, consumer's engagement with physical activity has seen some setbacks and CDC reports only a slight decline in people reporting no leisure time physical activity over the last twenty years [61]. This combination of developments

suggests that individuals preferred path towards weight loss may not always be through physical activity.

Industry has been fairly receptive to rising consumer awareness of weight loss. Many companies are offering an increased selection of related products in a variety of categories. For example, in recent years food and beverage products are increasingly advertising known health benefits such as "No Trans Fat," "High Fiber/Whole Grain," "100% Real Fruit," "Low Salt/Sodium," and "Natural/Organic." However, the trend towards internet shopping and super stores while providing the convenience of one-stop shopping also reduces the physical activity necessary for daily activities with parallel increases in morbidity and mortality.

An interesting new development has focused on the promise of smart clothes and shoes in helping to maintain a physically active lifestyle across the lifespan. The advent of mobile computing, miniaturized electronics, and ubiquitous Wi-Fi has introduced the possibility for individuals of any age to wear clothing, shoes, and head bands or hats that continuously measure physical activity, body weight, and physiological signals safely and non-invasively. This is as true for the neonatal infant, as it is for the professional athlete and the frailest of nursing home residents. Body-worn sensors can be networked via fine wires sewn into the fabric of clothing, or conductive pathways coating certain threads in textiles. In addition, body-worn sensor networks can be linked wirelessly to a PDA worn by the individual, or via Wi-Fi, to a central recording location for computer and data storage facility where it is needed. These modern instruments and products can serve to encourage a healthier lifestyle.

Physical activity can already be monitored using miniature inertial measurement units (IMU) that continuously measure the linear accelerations and angular velocities of each body segment. A magnetometer in the IMU continuously tracks the posture of one or more body segments with respect to gravity, so one can ascertain whether an individual is sleeping, sitting, standing, or locomoting. A GPS sensor can track horizontal and vertical distance moved to check the distance walked or run for exercise. Other sensors can non-invasively track heart rate, body temperature, muscle activity, body weight via the pressure under the feet when standing, pressures on the skin of a vulnerable body part to prevent ulcers while sitting or sleeping, the number of movements during sleep to evaluate sleep quality, the excess tension on the waist belt used to keep trousers up due to inadvertent adiposity, inadvertent urine loss for those with incontinence, falls in the elderly, concussion in the athlete, and even the activity of surface networks in the brain. Sensors are already so small and inexpensive that they can even be placed in food to monitor gastric health and vital signs internally, after which they are discarded with body waste. By the year 2030 it is safe to assume that the routine use of body worn, and likely also implanted, sensor networks, will routinely be used to monitor all the physiological signs needed to optimize health both when awake and asleep.

The use of biofeedback from these sensors will allow an individual, family member, trainer, coach or physician to monitor activity levels and determine whether they are less than adequate, optimal, or have reached a level that they

are likely to be injurious due to overuse. Social networking is already allowing individuals to compare physical activity logs, and this is likely to become increasingly widespread, potentially serving as an important incentive to engage in physical activity. The use of miniature body-worn actuators, such as vibrators, mounted in clothing already allows users to receive feedback on negative or positive behaviors, to learn new skills via knowledge of results, or relearn old skills like walking during a rehabilitation program. They can even be used to warn drowsy drivers when their behavior has become dangerous to themselves and others.

As this brief overview indicates, there are numerous developments at the product or corporate level which can positively or negatively influence physical activity. As an example, when coupled with incentives, the development of inexpensive "smart" clothing and body-worn instrumentation holds a great deal of promise for reducing the negative while fostering behaviors and behavior change consistent with a healthy lifestyle across the lifespan.

## 5. Country

Insights from the brain may help predict responsiveness to public efforts to proactively influence behavior. Mass media representations of people being active (or sedentary) may be one important way in which norms around physical activity develop. As such, an understanding of media effects is essential to traversing levels of analysis from culture to creature (Figure 1). Important sources of mediated social influence include public service announcements, representations of activity norms in entertainment media, and other forms of persuasive messaging (e.g., advertisements). However, not all messages are equally effective in motivating behavior change, and not all individuals are equally affected by messages promoting healthy changes.

Recent neuroimaging research suggests that the brain may offer insights about the potential success of media campaigns, above and beyond people's self-reports. For example, neural responses to public service announcements promoting sunscreen use [62] and smoking [63] predict individual behavior change in the weeks and months following the scan. Furthermore, these neural data explain variance in behavior change above and beyond individual participants' reports of their intentions to change their behavior, their attitudes about the behavior, their confidence in their ability to change their behavior, and their ability to relate to the advertisements. Likewise, neural activity may also help scientists and practitioners select the best messages and interventions to motivate the largest number of people. Smokers' neural activity in response to advertising campaigns promoting the National Cancer Institute's tobacco quitline correctly predicted the success of the different campaigns in increasing quitline call volume at the population level, whereas the participant's self-reports of which advertisements they thought would be most effective did not [64]. Researchers have also demonstrated the utility of neuroimaging in predicting the popularity of other types of media [65]. Such methods have not been applied to predict the success of messages or interventions targeting physical activity, but these methods may be applied to design messages and interventions to bend, that is, improve, the health care cost curve over the next several decades.

Finally, the brain can aid in our understanding of the basic mechanisms that lead people to make healthy decisions, and to successfully change their behavior toward healthier habits. For example, cognitive control activity in the brain during a response inhibition task predicts smokers' ability to break the link between craving and smoking [66], and activity in the brain's reward network in response to food stimuli predicts changes in body mass index over the months following the scan [67]. This brain-as-predictor approach [68] may also be key in developing our understanding of the mechanisms that lead people to be successful in increasing their physical activity.

Social Media, defined as "any online platform or channel for user generated content" [69] includes networking portals such as Facebook, MySpace, and LinkedIn; instant messaging systems such as Twitter; online video-sharing websites such as YouTube; photo-sharing websites such as Flickr; and blogging platforms such as Tumblr, among many others [70]. Social media platforms and technologies have evolved dramatically, and have become nearly ubiquitous given their popularity among younger cohorts. American adolescents are actively engaging with peers through social media outlets, with studies reporting that they spend more than 2 hours per day on the internet and on average, 80% of that time is spent on a social network [71]. In addition to their growing use of social media, adolescents today are also more likely to carry a cell phone than any previous generation. In fact, mobile phones are nearly ubiquitous among U.S. teens, with three-quarters of them reportedly owning a mobile phone in 2010 [72]. This trend appears to be worldwide.

Obesity prevalence among U.S. children, defined as BMI ≥ 95th percentile for age and sex, has increased dramatically, with a greater than 3-fold rise since 1976—rising from approximately 5% to 17% [4, 73]. Despite evidence that physical activity could, in part, mitigate this dire trend, studies show that U.S. adolescents are not getting sufficient exercise [74]. Only about one-half of U.S. adolescents reportedly participated in vigorous physical activity on a regular basis in 1996; one-fourth reported no vigorous physical activity at all [74]. Since the adolescents of today are the middle-aged adults of 2030, these trends do not bode well for the health and well-being of our society in 2030. Given these trends, there is a growing interest among public health professionals to leverage social media platforms to incentivize adolescents to engage in healthy behaviors. The effectiveness of these tactics would likely hinge on the proven effects of social networks and peer groups on individual activity. Studies have shown that physical activity levels among adolescent females are enhanced by having friends who are more physically active [75], and that positive feedback is also an important element or factor contributing to enhanced levels of physical activity [76–79]. Social media and mobile technology therefore have the potential to leverage these effects as they relate to levels of adolescent physical activity.

There is evidence from the literature that social media and mobile platforms can be used to successfully promote

physical activity. One recent study of U.S. college students found that a weight-loss program that was administered to participants through Facebook and Twitter was indeed effective [80]. In another recent study of overweight adults, researchers found that text-messaging was a productive means of promoting behaviors supporting weight loss [81]. These results are promising. Based on this trend, there is an increasing number of social media applications geared towards fitness and overall health—particularly those with mobile accessibility—that have the potential to mitigate low levels of physical activity.

Fitocracy and MapMyFITNESS are two examples of fitness social networks, accessible through online platforms that connect users who are devoted to exercise. These sites allow users to log workouts, follow friends' workouts, count calories burned, and be awarded points for achieving fitness goals. By leveraging the productive influences of social and peer engagement, these platforms and others like them may serve to incentivize users to increase their physical activity and to live healthier lives.

Gaming is another emerging phenomenon on social media and mobile platforms. The Pew Research Center study reported in 2010 that 46% of teen cell phone owners played games on their mobile phones [82]. A second study conducted by ROIWORLD, an online gaming site, found that much of the time spent by teens on social network sites was devoted to playing video games. In fact, gamers on Facebook and MySpace reported spending 6+ hours per week playing games [71]. Gaming has been implicated as a potential determinant of the childhood obesity epidemic, but researchers are now leveraging gaming technology to help combat the epidemic. A number of studies have evaluated the effectiveness of using video games to increase physical activity [83, 84]. Some studies have found that active games like Nintendo Wii's dance, dance revolution (DDR) could improve physical fitness in children [85–87], and in one instance provides a more vigorous workout compared with walking on a treadmill at 3 miles per hour [85]. Location based games are another creative avenue for increasing physical activity. SCVNGR is a mobile application available to iPhone and Android users, which provides location based alerts through the GPS on the phone. This allows users to devise challenges or games at specified locations, select a competitor for the challenge among their social network, and earn points once those challenges are completed. SCVNGR could be used as a game to encourage physical activity across a geographic space, by having adolescents walk to different physical locations, motivated by the games or challenges and their social network of friends/competitors. The potential of mobile and social media platforms for improving physical activity levels among youth, and possibly adults of all ages, are endless.

Despite these promising developments a note of caution should be raised. Exercise interventions and guidelines should not be excessive or raise unrealistic expectations. Since recent evidence [16] has shown that even mild to moderate amounts of physical activity can have significant health benefits, all levels of activity should be recognized and applauded.

## 6. Future Directions and Concluding Remarks

In this paper we highlight the alarming trend of inactivity among children, adolescents, young, middle, and older people. We summarize evidence indicating that growing trends of increased obesity, related illnesses and disabilities will result, by 2030, in a population that is heavier, sicker, and more disabled, and a society that is overburdened with health costs and is considerably less productive. We urge a proactive approach which benefits from the well known significant and positive effects of physical activity and outline methods to encourage this low cost, pervasively effective health behavior. We have presented a multidimensional theoretical framework, ranging from cells to culture, that focuses on the intersectionality of those factors influencing physical activity across the lifespan. We highlight specific intervention possibilities of select dimensions of the model.

Further, we posit there are direct effects the corporation/organization (as an employer) has directly on its employees and family through an architecture of positive health behaviors that are either forced or incented. The longer-term effects are increased positive health for employees and those familial members touched by the health care coverage umbrella. These same corporations/organizations have indirect effects on the communities and country/culture in which they operate through their messaging about the right to move and the importance of improved physical activity on the part of their employees and families. They may also use messaging (and sponsorships) toward their customers to engage in healthier lifestyles via products/services that reinforce the central theme.

We further emphasize the importance of working within multidisciplinary teams that include academic researchers and corporate partners who will recognize the importance of incentivizing physical activities and of empowering individuals with the right to move, thereby optimizing the potential of health and well-being across the life-span, especially through active aging.

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*Research Article*

# Active Ageing: An Empirical Approach to the WHO Model

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*Background*. In the beginning of the 21st century, the world summit on population taking place in Madrid approved active ageing, WHO (2002) as the main objective of health and social policies for old people. Few studies have been done on the scientific validity of the construct. This study aims to validate the construct of active ageing and test empirically the WHO (2002) model of Active Ageing in a sample of community-dwelling seniors. *Methods*. 1322 old people living in the community were interviewed using an extensive assessment protocol to measure WHO's determinants of active ageing and performed an exploratory factor analysis followed by a confirmatory factor analyses. *Results*. We did not confirm the active ageing model, as most of the groups of determinants are either not independent or not significant. We got to a six-factor model (health, psychological component, cognitive performance, social relationships, biobehavioural component, and personality) explaining 54.6% of total variance. *Conclusion*. The present paper shows that there are objective as well as subjective variables contributing to active ageing and that psychological variables seem to give a very important contribute to the construct. The profile of active ageing is expected to vary between contexts and cultures and can be used to guide specific community and individually based interventions.

## 1. Introduction

The World Health Organization (WHO) defines active ageing as "*... the process of optimizing opportunities for health, participation, and security in order to enhance quality of life as people age*" [1]. The emergence of this concept back in the 1990s developed through the WHO and several other governmental and nongovernmental organization initiatives offers a policy framework that emphasizes the link between activity, health, independence, and ageing well. In being of unquestionable importance as a key policy concept, efforts to add some empirical evidence on its operative definition and criteria are still scarce. As a potential variation of other terms used interchangeably in the gerontological literature as positive and productive ageing, the interpretation of active ageing often focuses on the labour market participation anchored in an economic framework [2] or in a perspective strongly health oriented, though the WHO does take an multidimensional approach and a broad view of "health." In fact, for many years WHO used to talk about healthy ageing, considering primary ageing without major pathologies, and only in the XXI century this concept was substituted by the more comprehensive concept of active ageing, considering not only health indicators but also psychological, social, and economic aspects, which are to be looked through communities' approaches within gender and cultural perspectives.

Notwithstanding the established importance of WHO's concept of active ageing as the leading global policy strategy in Europe [3], the scientific interest on its empirical dimension seems scarce at an international level. Based on a literature review using the key words "active ageing" and "WHO (2002)" on HighWire plus Medline, we found only 8 articles referring to the existence of the political framework proposed by WHO. In PsyInfo database, results were even scarcer with only two comments on Fernandez-Ballesteros' book on active ageing [4]. It seems that the document produced by

WHO is more relevant in Europe than in the USA, with many countries introducing the model recommendations into their national health and social plans of action although, in general, it did not elicit many scientific discussion. In USA, researchers seem not to use the concept boosted by WHO in 2002 in their scientific papers and prefer to use the parallel concept of "successful ageing" as proposed by Rowe and Kahn [5, 6] when referring to ageing well or optimal ageing. As a matter of fact, for the concept "successful ageing" we found 3587 papers in the same data bases.

### 1.1. The Active Ageing Model.

The concept of active ageing [1] is based on three pillars mentioned in the definition: participation, health, and security. The proposed model encompasses six groups of determinants, each one including several aspects: (1) health and social services (promoting health and preventing disease; health services; continuous care; mental health care); (2) behavioral (smoking; physical activity; food intake; oral health; alcohol; medication); (3) personal (biology and genetics and psychological factors); (4) physical environment (friendly environment; safety houses; falls; absence of pollution); (5) social (social support; violence and abuse; education); (6) economic (wage; social security; work), embedded in cultural and gender context, with recommendations for health policy for old people, to be implemented through national health plans all over the world, during the first decade of the XXI century.

According to the WHO document on active ageing [1], the key aspects of active ageing are (1) autonomy which is the perceived ability to control, cope with, and make personal decisions about how one lives on a day-to-day basis, according to one's own rules and preferences; (2) independence, the ability to perform functions related to daily living—that is the capacity of living independently in the community with no and/or little help from others; (3) quality of life that is "*an individual's perception of his or her position in life in the context of the culture and value system where they live, and in relation to their goals, expectations, standards, and concerns. It is a broad ranging concept, incorporating in a complex way the person's physical health, psychological state, level of independence, social relationships, personal beliefs, and relationship to salient features in the environment.*" [7]. As people age, their quality of life is largely determined by their ability to maintain autonomy and independence and (4) healthy life expectancy which is how long people can expect to live without disabilities.

Active ageing appears as an outcome of different determinants that should allow us to identify particular profiles that are more at risk or, on the other hand, are more favorable to age actively.

### 1.2. Measuring Successful and Active Ageing.

Recently, Pruchno et al. [8] wrote a paper on the early and contemporary characteristics of successful ageing. The authors stressed the proliferation of research on this topic over the past 50 years yet the inexistence of harmony on its definition and measure. The main point was to understand the influence of genetic and early experiences, as well as

actual behaviors of individuals on ageing outcomes. Based on latent profile analyses, they concluded that successful ageing is a multidimensional construct that includes both objective and subjective characteristics, and that ageing outcomes can be modifiable by current behaviors. In another paper, Pruchno et al. [9] tested the two factor model of successful ageing by doing a confirmatory factor analyses. Factors were objective success (ample functional abilities, little or no pain, and few chronic diseases) and subjective success (perceptions of ageing successfully, ageing well, and overall evaluation of current state of one's life). They showed that age and gender were associated with objective but not subjective perceptions of successful ageing.

Previous discussion on the issue of objective versus subjective variables of successful ageing had stressed the idea that the proportion of people claiming ageing successfully is higher than the proportion of people classified as successful agers by objective indicators [10]. These authors found 92% of old people perceiving themselves as successful, although they were not free of disease or disability. The majority of subjects met the criteria for independent living, mastery, positive adaptation, life satisfaction, and active engagement, and only 15% met the criteria for absence of physical illness, and 28% reported no physical limitation. Successful ageing was not related to age, gender, ethnicity, marital status, education, and income which emphasize, in our view, the psychosocial variables of successful ageing over other characteristics of individuals.

In a different society (Taiwan), Lee et al. [11] confirmed a four-factor model of successful ageing. Again leisure activities appeared as a very relevant factor to the successful ageing process. Chaves et al. [12] studied the predictors of normal and successful ageing in urban old Brazilians and found 62% successful old people that fulfill the criteria of health and independence, differing from "normal" ones, namely, in the amount of leisure activities. In this same study, the number of living children appeared as a risk factor, whereas confidents and family income were protective factors of successful ageing. Authors discussed these findings considering that in developing countries as Brazil, contrarily to developed ones, socioeconomic status and social network seem to be more important than biological variables to predict successful ageing.

When examining the concept of ageing well in Europe and Latin America, Fernández-Ballesteros et al. [13, 14] found evidence of considerable consistency across countries, continents, and ages. The common thoughts toward ageing were that healthy ageing was the most important factor followed by independence (ability to manage oneself) and social implication which included positive affect. The ability to learn new things and the ability to work after retirement, as well as feeling able to influence others and staying involved with the world and people were considered less important. These results are quite similar to those of Bowling [15] that reported that over three-quarters of respondents were classified as ageing successfully, with self-perceived health status and quality of life as predictors of self-rated successful ageing. This author considers that the biomedical perspective of successful ageing needs balancing with a psychosocial one.

McLaughlin et al. [16] based on the Rowe and Kahn model [5, 6] had already estimated the prevalence of successful ageing on a national sample of older adults. The factors considered were disease and disability, cognitive and physical functioning, and social connections and productive activities. Results showed that only 11.9% individuals were ageing successfully every year, and that this percentage lowered in 25% between 1998 and 2004. The probability of being successful is lower for those with advanced age, male gender, and lower socioeconomic status. Based in this analysis, the authors considered that there is a need for modification in the concept of successful ageing for public health purposes. Depp and Jeste [17] made an extensive review on successful ageing studies and found in 28 selected studies that 26 of them included disability and very few psychosocial variables. The most frequent correlates of successful ageing were young age, no smoking, and absence of disability, arthritis, and diabetes. About 1/3 of individuals were ageing successfully, although the differences from study to study were large.

When explicitly exploring the concept of active ageing, Bowling [18] reported that a third of respondents rated themselves as ageing "very actively" and almost a half as "fairly actively." The most common perceptions of active ageing were having/maintaining physical health and functioning (43%), leisure and social activities (34%), mental functioning and activity (18%), and social relationships and contacts (15%). The predictors of positive self-rated active ageing were optimum health and quality of life. More recently, Stenner et al. [19] reported the subjective aspects of active ageing by inquiring people about the meaning of the words "active ageing." The authors showed that most people refer physical activity but also autonomy, interest in life, coping with challenges, and keeping up with the world. As mentioned, people mix physical, mental, and social factors and stressed *agentic capacities* and living by one's own norms. The authors criticized the deterministic view of the WHO model and emphasized the need for a "challenge and response" framework, a psychosocial approach to the conflict between facts and expectations, and the proactive attitude of people.

In overall, successful ageing, active ageing, and other related terms as positive ageing or ageing well are viewed as scientific concepts operationally portrayed by a broad set of biopsychosocial factors, assessed through objective and subjective indicators as well as being closely related to lay concepts reported cross-culturally by older persons [20]. Considering the heterogeneity of old people and the huge variety of individual trajectories, it is difficult, and probably ineffective, to define the core concept of successful ageing. A strict pattern of success excludes too much people all around the world, and an attempt to establish a standard for successful ageing, even a hypothetical biomedical objective standard, does not embrace the differences observed in old people (e.g., those with born or acquired incapacity). The concept of active ageing, although very difficult to measure, seems less deterministic, either as an outcome or as a process of achieving it. On the contrary, the well-known concept of successful ageing of Rowe and Kahn [5] looks more narrow and unrealistic, considering the very small amount of people (around 8.5%) that fulfill the criteria of ageing well [21].

In this paper, we explore the WHO's model of active ageing [1] that embraces positive outcomes of the ageing process. It is a challenge to examine the validity of the model and its empirical potential to foster quality of life in old people. Although we cannot really speak about "determinants of active ageing" as we cannot assert any causality without having a clear dependent variable and by doing a cross-sectional research, we intended to understand which and how the groups of variables are associated with active ageing. The main purpose of this research was to (i) built a protocol to assess WHO active ageing model and (ii) to verify which are the determinants that better explain active ageing.

## 2. Methods

*2.1. Data Collection.* This paper is part of an extensive Portuguese project on active ageing (DIA project) that includes a cross-sectional survey of adults aged 55+ years living in the community. For this study, subjects were recruited through announcements in local newspapers, local agencies (e.g., seniors clubs), and NGO's and using the snowball method by which participants indicate other persons with similar conditions. The study ran in different Portuguese regions, including the Madeira and Azores islands. The survey was conducted by trained interviewers, using a structured questionnaire format that entailed demographic, psychological, and social questions. A full description of the assessment protocol (P3A) can be found in Paúl et al. [22] and at http://www.projectodia.com. The interviews took place in local community facilities (e.g., parish hall) or at the participants' homes. Informed written consents were obtained from all the participants.

*2.2. Sample Characteristics.* The sample comprises 1322 persons aged 55–101 years old. The average age was 70.4 years (SD 8.7 years), and females comprised 71.1% ($n = 939$) of the sample. The majority of participants were married/partnered ($n = 729$, 55.7%), 400 (30.6%) were widowed, 114 (8.7%) were single, and 65 (5.0%) were divorced. As for the social network, 24.7% of the participants lived alone. Primary school education was reported by 55.3% of the respondents, 19.1% had never attended school, 17.8% had completed high-school, and 7.7% had higher education (trade qualification or university degree). Most participants (49.6%) had a monthly income equal or less than 386€ (by reference to the Portuguese Minimum National Wage in 2006). For the statistical analysis, as the distribution of missing values did not follow a pattern, participants with at least one missing response were eliminated, and the final sample contains 925 persons. The actual sample diverges from the national distribution of characteristics of old people [23], in the percentage of men and women in the sample, with a higher percentage of women in our sample than the existing in the Portuguese population 55+ years (71% versus 57% women) and the percentage of married individuals and widows (55.7% versus 71.1% married and 30.6% versus 20.1% widows). A special mention is to be made on the percentage of illiterate people in our study

TABLE 1: Instruments used for each of the WHO's active ageing model determinants.

| Determinants | WHO (2002) contents | Assessment protocol "P3A" | | |
|---|---|---|---|---|
| Personal factors | Biology and genetics psychological factors | Psychological distress | | GHQ-12 [28] |
| | | Happiness | | QBE/F [32] |
| | | Cognitive functioning | | MMSE [25] |
| | | Personality | | NEO (Costa and McCrae, 1992 [31]) |
| | | Optimism | | LOT-R [30] |
| | | Loneliness | | Loneliness scale (Paúl et al., 2008 [22]) |
| Behavior determinants | Smoking Physical activity Food intake Oral health Alcohol Medication | Pulmonary function | | Peak flow |
| | | Strength | | Hand grip |
| | | Subjective health | | |
| | | Illness | | |
| | | Sleep problems | | |
| | | Subj. physical activity | | Health and life styles questionnaire (ESAP, Fernández-Ballesteros et al., 2004 [24]) |
| | | Vision | | |
| | | Audition | | |
| | | Smoking | | |
| | | Drinking | | |
| | | ADL and IADL | | |
| Determinants of social environment | Social support Violence and abuse | Social network | | Lubben scale of social support (Lubben, 1988) [27] |
| | Education | Education | | Sociodemographic questionnaire |
| Determinants of health and social services | Health and disease Health services Continuous care Mental health care | Life satisfaction | | Inventory of life satisfaction (Fonseca et al., 2011 [34]) |
| Determinants of physical environment | Friendly environment Safety houses Falls Absence of pollution | Environment domain of quality of life | | WHOQOL Brief—physical environment subscale (Harper et al.,1998 [7], Canavarro et al., 2010 [33]) |
| Economic determinants | Wage Social security Work | Income | | Socioeconomic status (National Institute of Statistics) |

which is similar to the national figures: 19.1% versus 17% for people 15+ years.

*2.3. Measures.* The protocol measures the different groups of determinants of WHO's active ageing model and was elaborated considering an extensive literature review of most common instruments used in Gerontology and previously used the European Survey on Ageing Protocol [24] (Table 1). All instruments are adapted to Portuguese.

Along with socio demographic characteristics (gender, age, education, and income), we analyzed cognitive functioning as measured by the Portuguese version of the Minimental State Examination (MMSE) adapted to illiterate people and to people with very few years of education [25, 26]; social network was assessed with the Lubben Social Network Scale (LSNS) which comprises three subscales—family, friends, and confidants [27]; psychological distress was measured

with General Health Questionnaire (GHQ-12) [28]; optimism was assessed with the Portuguese Version of the Life Orientation Test-Revised (LOT-R) [29, 30]; personality was evaluated with the NEO Personality Inventory [31] which comprises three subscales—neuroticism, extraversion, and openness to experience; happiness was assessed with a single question with four categories [32]; and environment domain of quality of life was measured with World Health Organization Quality of Life-BREF (WHOQOL-BREF) [7, 33] and Inventory of Life Satisfaction [34]. Biobehavioral measures, including pulmonary function and strength, were assessed using a standard "Mini Peak Flow Meter" (Datosprir Peak-10, Sibelmed) and with an electronic dynamometer (Grip-D, TAKEI Scientific Instruments Co., LTD), respectively. Finally, health and physical condition were evaluated by self-report indicators (determined by a standard health-rating item: "In general, how would you rate your health?"), illness (sum

TABLE 2: Definition of variables.

| Variable | Coding |
| --- | --- |
| Subjective health | 1 = very good; 2 = good; 3 = reasonable; 4 = poor; 5 = very poor |
| Sleep problems | 0 = no; 1 = yes |
| Subjective physical activity | 1 = very good; 2 = good; 3 = reasonable; 4 = poor; 5 = very poor |
| ADL | 0 = with difficulties; 1 = without difficulties |
| Illness | 0 = none; 1 = 1 illness; 2 = 2 illness; 3 = 3 illness; 4 = 4 or more illness |
| Psychological distress[a] | 1 = <9; 2 = [9, 12[; 3 = [12, 16[; 4 = ≥16 |
| Happiness | 1 = nothing; 2 = 2; 3 = 3; 4 = very |
| Optimism[a] | 1 = <11; 2 = [11, 13[; 3 = [13, 15[; 4 = ≥15 |
| Quality of life[a] | 1 = <24; 2 = [24, 26[; 3 = [26, 29[; 4 = ≥29 |
| Loneliness | 0 = yes; 1 = no |
| Cognitive impairment[a] | 1 = <25; 2 = [25, 28[; 3 = [28, 30[; 4 = ≥30 |
| Vision | 1 = no specs and very poor/poor vision; 2 = no specs and acceptable vision; 3 = no specs and good/very good vision; 4 = specs and very poor/poor vision; 5 = specs and acceptable vision; 6 = specs and good/very good vision |
| Audition | 1 = no device use and very good/good audition; 2 = no device use and acceptable audition/3 = no device use and poor/very poor audition; 4 = use device |
| Smoking | 1 = no; 2 = ex-smoker; 3 = yes |
| Drinking | 1 = never; 2 = special occasions; 3 = occasionally; 4 = regularly |
| Income[b] | 1 = ≤386 €; 2 = 386 €–772 €; 3 = 772 €–1158 €; 4 = >1158 € |
| Education level | 1 = no formal; 2 = primary; 3 = 5–8 years; 4 = 9–12 years; 5 = university |
| Peak flow[a] | 1 = <180; 2 = [180, 250[; 3 = [250, 340[; 4 = ≥340 |
| Grip strength[a] | 1 = <18.3; 2 = [18.3, 22.9[; 3 = [22.9, 29.0[; 4 = ≥29.0 |
| Family[a] | 1 = <9; 2 = [9, 11[; 3 = [11, 13[; 4 = ≥13 |
| Friends[a] | 1 = <5; 2 = [5, 8[; 3 = [8, 10[; 4 = ≥10 |
| Confidents[a] | 1 = <4; 2 = [4, 7[; 3 = [7, 9[; 4 = ≥9 |
| Neuroticism[a] | 1 = <30; 2 = [30, 34[; 3 = [34, 37[; 4 = ≥37 |
| Extraversion[a] | 1 = <39; 2 = [39, 41[; 3 = [41, 44[; 4 = ≥44 |
| Openness to experience[a] | 1 = <35; 2 = [35, 37[; 3 = [37, 40[; 4 = ≥40 |

[a] Quartiles; [b] by reference to the Portuguese Minimum National Wage in 2006.

of self-reported health problems), sleep problems, subjective physical activity (determined by the item: "In general, how would you rate your physical condition?"), ADL, loneliness, vision, audition, smoking, and drinking. Details regarding variables and coding are shown in Table 2.

*2.4. Exploratory Factor Analysis.* The factor structure of P3A was examined by exploratory factor analysis, using principal-components extraction with varimax rotation. For the continuous variables, we used the quartiles in order to standardize the variables and use only categorical variables in the exploratory factor analysis. Exploratory factor analysis was conducted using SPSS 17.0 for Windows.

*2.5. Confirmatory Factor Analysis.* Confirmatory factor analysis was conducted to test the viability of a hypothesized structure that had been formulated from theoretical considerations and results of the exploratory factor analysis. Confirmatory factor analysis was conducted using AMOS 18 for Windows. Satisfaction scores for each dimension

were obtained using factor score regressions generated from the confirmatory factor analysis as proportional weight to combine item scores. Our process of analysis started with the full factors and items, and then we used a nested models approach to test alternative nested structures to test fit improvement. In addition to theoretical and practical considerations, evaluation of fit of model was based on the following goodness of fit criteria, including normed chi-squared ($\chi^2/df$), the comparative fit index (CFI), the goodness of fit index (GFI), the Akaike's information criteria (AIC), and the Browne-Cudeck criterion (BCC). CFI and GFI indices assume values in range from 0 to 1, with higher scores indicating better fit. Models with the lowest values of AIC are most likely to be good fits. We used the chi-square difference statistics to test the significance of the change in the chi-square test for each alternative model over the full model. Lastly, we examined the effect of age and gender on the final model estimating paths between age and gender and factors. Nonsignificant paths were removed, and the model was estimated over and over until only significant paths remained.

TABLE 3: Factor structure of P3A—exploratory factor analysis.

| Questions | Factors | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Subjective health | **0.652** | −0.298 | −0.312 | −0.071 | −0.131 | −0.104 |
| Sleep problems | **0.620** | −0.154 | 0.152 | 0.133 | −0.114 | 0.260 |
| Subjective physical condition | **0.670** | −0.218 | −0.250 | −0.061 | −0.104 | −0.223 |
| ADL | **−0.563** | 0.052 | 0.262 | 0.160 | −0.103 | 0.139 |
| Illness | **0.673** | −0.067 | 0.004 | −0.241 | 0.009 | 0.035 |
| Psychological distress | 0.437 | **−0.586** | −0.101 | −0.084 | −0.112 | −0.005 |
| Happiness | −0.265 | **0.540** | 0.105 | −0.085 | 0.260 | 0.213 |
| Optimism | −0.050 | **0.683** | −0.035 | 0.039 | 0.065 | 0.068 |
| Neuroticism | 0.096 | **−0.695** | −0.114 | −0.163 | 0.171 | 0.108 |
| Quality of life—environment | −0.076 | **0.616** | 0.286 | 0.075 | 0.051 | 0.132 |
| Loneliness | −0.149 | **0.492** | −0.011 | 0.126 | 0.351 | −0.084 |
| Cognitive impairment | −0.096 | 0.180 | **0.594** | 0.396 | 0.103 | −0.146 |
| Vision | −0.100 | −0.001 | **0.592** | −0.211 | 0.056 | 0.242 |
| Income | −0.162 | 0.135 | **0.699** | 0.261 | 0.126 | −0.198 |
| Education level | −0.098 | 0.133 | **0.807** | 0.204 | 0.034 | −0.199 |
| Peak flow | −0.044 | 0.157 | 0.295 | **0.700** | 0.056 | −0.051 |
| Grip strength | −0.266 | 0.098 | 0.042 | **0.782** | 0.060 | 0.058 |
| Social relations—family | −0.028 | 0.109 | −0.006 | 0.112 | **0.727** | −0.063 |
| Social relations—friends | −0.131 | 0.074 | 0.130 | 0.078 | **0.400** | 0.269 |
| Social relations—confidence | 0.024 | 0.013 | 0.104 | −0.065 | **0.700** | 0.011 |
| Extraversion | −0.196 | 0.106 | −0.027 | −0.199 | 0.055 | **0.655** |
| Openness to experience | 0.123 | 0.014 | −0.190 | 0.143 | −0.016 | **0.734** |
| % of variance explained | 11.6 | 11.2 | 10.6 | 7.7 | 6.9 | 6.6 |
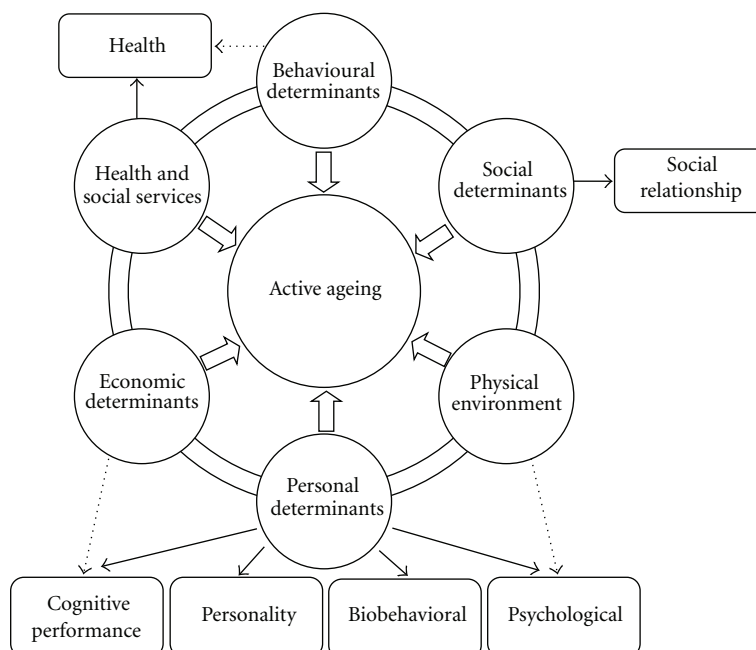


FIGURE 1: The WHO model and the empirically achieved model.

TABLE 4: Goodness-of-fit statistics for confirmatory factor analysis models of P3A.

| Model | $\chi^2$ | df | $\chi^2$/df | CFI | GFI | $\chi^2_{\text{dif}}$ | AIC | BCC |
|---|---|---|---|---|---|---|---|---|
| 1 | 701.342 | 194 | 3.615 | 0.891 | 0.936 | — | 819.342 | 822.354 |
| 2 | 562.046 | 172 | 3.268 | 0.913 | 0.946 | 139.30 | 680.046 | 682.924 |
| 3 | 557.039 | 155 | 3.594 | 0.908 | 0.944 | 5.01 | 667.039 | 669.597 |
| 4 | 489.170 | 153 | 3.197 | 0.923 | 0.950 | 67.87 | 603.170 | 605.822 |
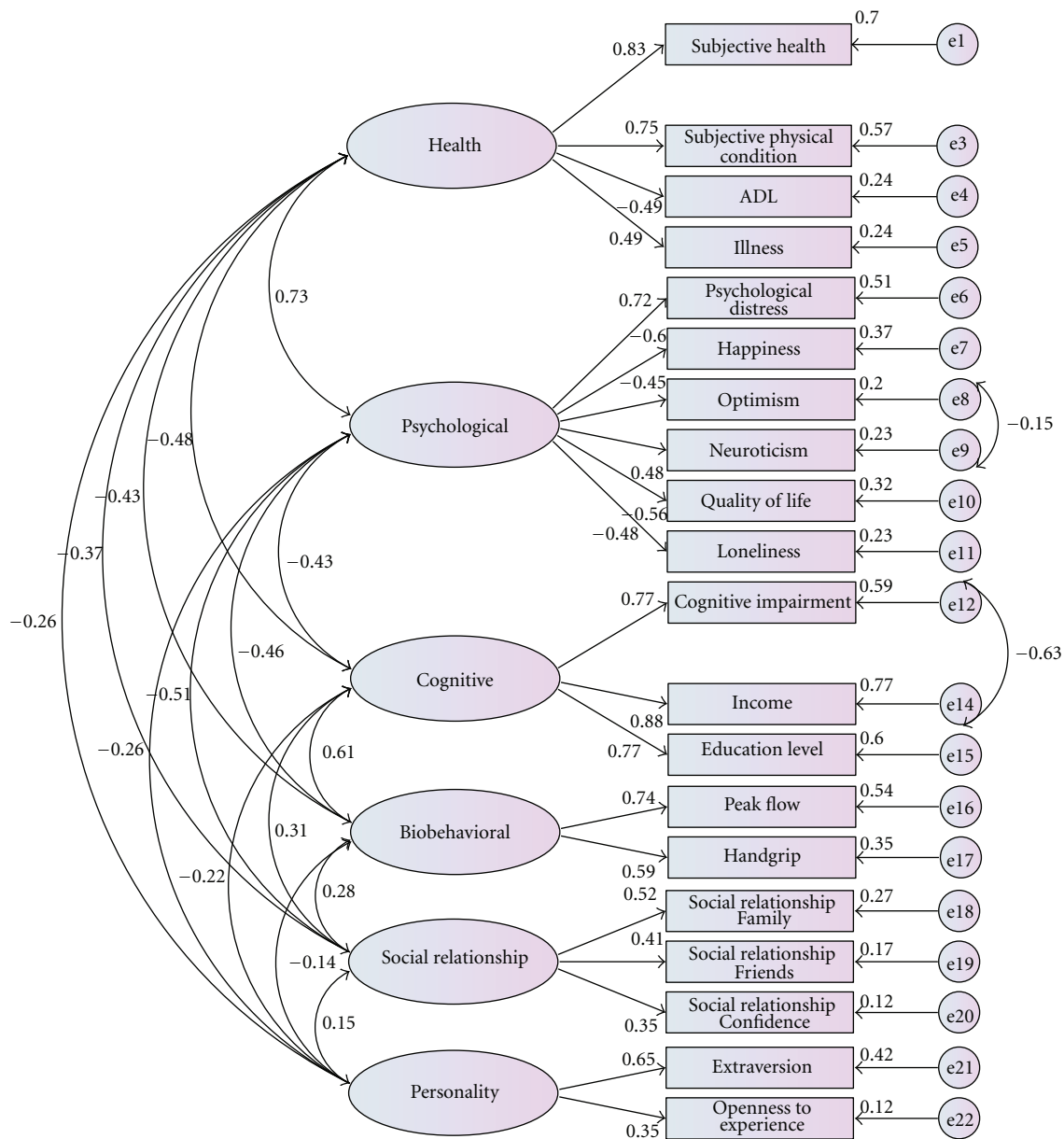


FIGURE 2: Factor structure model for P3A.

## 3. Results

*3.1. Descriptive Analysis.* Descriptive analysis (absolute and relative frequencies) was performed for all variables described in Table 2. When exploring the results, the variables "smoking" and "drinking" were excluded to the final analysis because distribution for this two variables were skewed, showing a pattern of responses in only one or two categories (e.g., no smokers; no heavy drinkers).

*3.2. Exploratory Factor Analysis.* The factor structure was examined by principal-components extraction with varimax rotation for the pooled sample ($n = 925$). The Bartlett

sphericity test and the Kaiser-Meyer-Olkin (KMO) test were performed; the first revealed a 0.001 level of significance and a KMO value of 0.855, indicating that factor analysis seemed to be highly adjusted to this analysis. Six distinct factors, accordingly to the theoretical six determinants of the WHO model, were revealed (Table 3), explaining 54.6% of total variance. The item "hearing" was eliminated because it had a loading lower than 0.3 in all factors.

(i) Factor 1. Health component: this factor comprises five variables (subjective health, sleep problems, subjective physical condition, ADL, and illness) and explained 11.6% of total variance.

(ii) Factor 2. Psychological component: six variables load heavily of this factor (psychological distress, happiness, optimism, neuroticism, quality of life—environment, and loneliness), which accounted for 11.2% of the total variance.

(iii) Factor 3. Cognitive performance component: four questions have their highest loadings on this factor (cognitive impairment, vision, income, and education level) and explained 10.6% of total variance.

(iv) Factor 4. Biological component: this factor comprises only two variables (peak flow and grip strength) and explained 7.7% of total variance.

(v) Factor 5. Social relationship component: three variables have their highest loadings on this factor (family, friends, and confidence), accounting for 6.9% of total variance.

(vi) Factor 6. Personality component: the last factor contains only two variables (extraversion and openness to experience) and explained 6.6% of total variance.

Comparing to the original model [1], our findings revealed a somewhat different one, depicted in Figure 1. *Health and social services determinants* merged with *behavior determinants* in a single component entitled "health" that includes functionality and life style. *Personal determinants* split into several components, namely, "psychological," "cognitive performance," "personality," and "biobehavioral." *Physical determinants* and *environment determinants* moved to the "psychological component" as a variable of perceived subjective well-being. *Economic determinants* migrated to the new component called "cognitive performance." Only *social determinants* stayed as an independent factor that we renamed "social relationships."

The achieved model shows that the "health component" is the major factor associated with active ageing and includes self-perception of health, the number of diagnosis, functionality (ADL and IADL), and life style. The second component was "psychological," which is frequently forgotten in literature, with the exception of psychopathological indicators. In this study, psychological variables include both negative affect (psychological distress, loneliness, and neuroticism) and positive affect (happiness, quality of life—environment, and optimism). The "cognitive performance component"

follows in weight showing the importance of wage, education, vision, and cognitive performance. The "biobehavioral component," comprising respiratory capacity and grip strength clearly shows the importance of biological aspects during the ageing process. "social relationship", including family, friends, and confidents, illustrates the relevance of social network for the quality of life of old people. Finally, the "personality component" was reduced to extraversion and openness to experience, as neuroticism merged with other psychological variables in the "psychological component." The profile is quite homogeneous with factors loading between 11.6% and 6.6% and explaining a good amount of total variance (54.6%).

*3.3. Confirmatory Factor Analysis.* We analyzed the full six-factor model for the 22 variables by using the six item clusters derived from the exploratory factor analysis (presented in Table 3). From the results of this first full model that replicated the measurement structure derived from the original exploratory factor analysis, we proposed alternative models. We used a nested models approach to test alternatives to the full model (Model 1), elimination of item "sleep problems" (Model 2), elimination of item "vision" (Model 3), adding the following covarying error variances between "optimism" and "neuroticism" items and between "cognitive impairment" and "income" items (Model 4). However, these do not introduce any change in the final model. Fit statistics of the full model and subsequent models are presented in Table 4.

The confirmatory factor analyses structure describes adequately the 6 factors reinforcing the adequacy of the proposed model. The various indices of fit presented in Table 4 suggest that satisfaction structure can be adequately described by the 6 correlated factors which are graphically presented in Figure 2 (Model 4). Latent constructs (active ageing components) are shown as ellipses, and questionnaire items measuring these latent constructs are represented as rectangles.

Finally, testing the effects of age and gender, only the paths between gender and the "cognition component" and gender and the "Biobehavioral component" were significant ($P < 0.05$, for both). Nonsignificant paths were removed, and the final model revealed that the model fit the data very well ($\chi^2 = 624.19$, $df = 171$, $P < 0.001$, CFI = 0.906, GFI = 0.941). Women had higher levels of "Cognitive performance component" and lower levels of "Biobehavioral component."

## 4. Discussion

When we look at the WHO model we can see that apart from the *social determinant* all the others endured a rearrangement that lead to six factors not similar to the original ones. However, "active ageing" remained a complex construct, where health and psychological adaptation play the major role. Many of the determinants proved to be entwined, reflecting the transaction between individual and environmental factors in shaping adaptation to the ageing process.

The *economic determinants* as well as the *physical environment* and *health and social services* relevance were found to be associated with personal needs, resources, and outcomes and do not configure independent factors. According to our findings, people seem to perceive and assess reality concerning social and personal conditions through the glasses of their own values and needs, adding to their real circumstances a self-perceived valuation of what they are experiencing. Globally, we can say that subjective and objective health and functionality constitute the main component of active ageing which goes in line with Pruchno et al. [8, 9] findings; the psychological component, be it positive characteristics of individuals (e.g., happiness, optimism) or pathological ones (e.g., psychological distress, neuroticism), is the second most relevant factor, reinforcing the idea of positive affect associated with less mortality and longevity (e.g., [35]); cognition appearing close to vision supports Baltes and Mayer's [36] findings on the importance of senses in cognition and in the overall optimal ageing. Income and education levels that contribute for this factor show, on one hand, the importance of cognition in the process of ageing and, on the other hand, a close association between income, access to education, and cognitive performance. Biological variables proved to be very sensitive to gender and age as expected (e.g., peak flow and grip strength), and contributing independently to active ageing; social relationship including family, friends, and confidents networks supports Bowling's [15] findings on the importance of social networks to successful ageing; finally, personality seems to introduce a factor of more or less adaptability to the challenges of ageing.

This achieved six-factor model reveals the major contributions the active ageing constructs and goes beyond the successful ageing model that establishes a strict pattern of success by considering that different profiles of old people in different contexts may be classified as active with areas in debt being compensated by more advantaged ones. The relative load of each factor will presumably change in diverse contexts or groups of people, emphasizing the need for different intervention programs to foster quality of life allocating diverse life trajectories, and where, for instance, high income can compensate smaller social networks or optimistic disposition can compensate disability to balance positively the process of ageing. Furthermore, rather than health problems that most of old people have (and/or expected to have in some extent) and some functional limitations, the difference between old people ageing actively or not may vary with the psychological characteristics and status that enable them to cope with ageing related declines, look forward, and keep committed to life. By keeping active in the broader sense of the concept, old people seem to overcome difficulties and keep highly motivated to participate in the social world and engage in healthy behaviors which raise quality of life during the ageing process. As stated recently here, a psychological approach to successful ageing is to have a crucial role in predicting future quality of live in older adults, namely, by maximizing one's self-efficacy and resilience [37].

The WHO active ageing model [1] based on 6 determinants was not empirically validated in its structure for the sample here considered. Some groups of determinants were found to be deeply intertwined. The proposed model requires further developments, namely, by studying psychological mechanisms that might be related to the ability to cope with ageing, and particularly among the very old. Culture-based approaches are also to be considered in future studies.

This study has two main limitations. The first one regards to the exclusive use of self-rated measures that may had led to an overall "perceived reality" whilst some of the active ageing determinants are to be more objective (e.g., actual presence of social and health services), although Portugal has a NHS with universal and free access and a reasonable coverage of services for the elderly (nursing homes and day centres and a not so extensive service of home care). On this aspect, it is worthwhile mentioning that most of the municipalities have conventional services for old people and that self-report of availability and satisfaction of community health and social services is thought to better reflect the reality and the experience of the present cohort of old people. Moreover, the use of mostly self-reported measures except for cognitive performance and biological parameters, although missing clinical diagnosis and objective environmental variables, constitutes a reliable overview of old people perspective of their own condition and that of the context in which they live. Both these aspects must be considered when interpreting our findings and when conducting further research. The second main limitation has to do with the sampling process (e.g., using announcements in newspapers, senior clubs) which may have resulted in a selection towards the most active older adults. We consider that further studies should comprise different sample selection procedures and a wider coverage of older people towards a more representative overview of the Portuguese population.

The challenge of active ageing is health and independent functioning, whereas psychological variables appear to be highly relevant determining the individual adaptation to the ageing process. In this sense, interventions are to consider the prevention of health problems from adulthood and the increasing of psychological resilience, avoiding loneliness or increasing happiness and subjective wellbeing. Other social and political variables demand different kinds of intervention at a community-based level, namely, rising income and carefully planning the retirement process and pensions regimens.

## Acknowledgment

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*Research Article*

# The Theory and Practice of Active Aging

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"Active aging" connotes a radically nontraditional paradigm of aging which posits possible improvement in health despite increasing longevity. The new paradigm is based upon postponing functional declines more than mortality declines and compressing morbidity into a shorter period later in life. This paradigm (Compression of Morbidity) contrasts with the old, where increasing longevity inevitably leads to increasing morbidity. We have focused our research on controlled longitudinal studies of aging. The Runners and Community Controls study began at age 58 in 1984 and the Health Risk Cohorts study at age 70 in 1986. We noted that disability was postponed by 14 to 16 years in vigorous exercisers compared with controls and postponed by 10 years in low-risk cohorts compared with higher risk. Mortality was also postponed, but too few persons had died for valid comparison of mortality and morbidity. With the new data presented here, age at death at 30% mortality is postponed by 7 years in Runners and age at death at 50% (median) mortality by 3.3 years compared to controls. Postponement of disability is more than double that of mortality in both studies. These differences increase over time, occur in all subgroups, and persist after statistical adjustment.

## 1. Introduction

"Active aging" and the related terms "healthy aging," "successful aging," "productive aging," "aging well," "living well," "senior wellness," and "compression of morbidity" endorse a radically nontraditional paradigm of human aging, which includes gains as well as losses and which posits possible improvement in future human health despite increasing longevity. Each of these terms, discussed briefly below, foresees a new paradigm for gerontology, based upon postponing functional declines into older ages with a goal of postponement of morbidity more than mortality, compressing morbidity into a shorter period later in life, and decreasing cumulative lifetime morbidity [1]. The new paradigm contrasts strikingly with the old "Failures of Success" paradigm, where improvements in longevity would inevitably lead to ever larger numbers of persons in ever poorer health [2].

There are differences in nuance between these terms and in the metrics by which they might be measured, and confusion might be reduced by greater agreement on terminology. We are most comfortable with "Compression of Morbidity" since it implies a strategy for improving health, the theory behind the strategy, and the means of testing progress, albeit a more technical term than alternatives. Of alternative terms, we prefer the term "healthy aging" since it includes the notion of improving each of physical health, mental health, and social health, whereas "active" seems more focused on the physical component of health, "productive" on some form of work product, "successful" on a quite narrow definition of aging, and "well" on the absence of disease. None of these terms are universally endorsed, but we need to recognize the common themes in these various restatements of the new paradigm.

Morbidity, in common usage, is a general term for the absence of health, and disability is the most frequently used metric for estimation of morbidity. Morbidity itself is an imprecise term often defined in different ways, usually denoting impaired health of some kind other than death. Morbidity itself does not have an agreed metric for its study. In practice, the most frequently used metric for estimation of morbidity has been ability at activities of daily living (ADL) as measured by the Health Assessment Questionnaire (HAQ) Disability Index [3] or similar instruments [4]. Such instruments measure physical capacity and disability on a continuous scale and indirectly include the cognitive abilities which ultimately direct the physical activity and the social environment which enables it [5].

This paper attempts to pull together evolving theory and evolving practice, with an emphasis on the history of the compression paradigm and the presentation of new longitudinal data over a twenty-year period now confirming compression of morbidity by lifestyle choices under certain conditions.

## 2. Theory

Over thirty years ago when I first began to examine the postulates of gerontology and human aging I did so from a background in medicine, rheumatology, clinical epidemiology, health outcomes research, and health policy, with an emphasis on prevention and on outcomes of chronic illness [6]. From this perspective, it seemed clear that much diminished capacity could be postponed or even prevented at the individual level and thus potentially at the population level. It also seemed clear that overall national improvements in health would likely require reduction in health risks [7, 8]. Thus, the marked reduction in heart disease mortality beginning in the nineteen-sixties was associated with decreases in risk factors such as smoking and cholesterol levels. These clearly affected both age-specific incidence rates and mortality rates. Disease-associated morbidity from heart disease now developed later in life and mortality also was postponed. An evolving challenge was to develop risk factor models on a population basis rather than a disease-specific one, since allocation of disability and other outcomes to specific diseases is difficult and competing risks make apportionment inaccurate as well.

There is a clear dynamic between changes over time in morbidity and in mortality, since fatal and nonfatal outcomes are generally correlated. However, postponement of morbidity by itself would improve health, while postponement of mortality by itself would increase ill-health. The dynamic interaction of morbidity trends and mortality trends was critical to accurate prediction of future health. If mortality was delayed the most, cumulative lifetime morbidity would grow; if morbidity was postponed more than mortality, cumulative lifetime morbidity would be likely to decrease. The prevalent aging paradigm of 1980, however, implicitly maintained that morbidity would continue to develop at a specific age, but that mortality could be postponed to an ever later age. Some even postulated no upper limit to human lifespan [2, 9, 10].

In retrospect, the inadequacy of the old paradigm is evident. At the time it began to be questioned, however, there were few data on trends in morbidity and trends in onset of morbidity could not be reliably estimated. Trends in mortality rates over many years, on the other hand, were readily ascertainable, reasonably accurate, and these rates were declining quite consistently over time. Gerontology was colloquially referred to as "the science of drawing downwardly sloping lines." The concept of the plasticity (modifiability) of aging, where markers of aging could sometimes improve instead of inevitably decline, was not often discussed. More complicated models were needed, where the dynamic relationship between morbidity and mortality rates could be understood. In turn, we needed

longitudinal population data on morbidity. We needed to be able to track the results of risk factors on both morbidity and mortality. Only as data became available could hypotheses of Compression of Morbidity be tested.

## 3. Science

Scholarly studies of Compression of Morbidity took several forms, the most definitive have involved (1) longitudinal study of morbidity in populations with differing risk factors, (2) population studies establishing decreases in population disability over long time periods, and (3) randomized controlled trials of health risk reduction in senior populations which showed decreased morbidity.

Other productive areas of study [11–16], noted but not elaborated here for reasons of space, include associations of health risk factors, morbidity, and increased medical care costs [11, 12]. Moreover, supercentenarians, over age 105, have proved to have had less lifetime cumulative morbidity than those dying at age 85 or 100 [13]. Programs based upon "active aging" concepts, most importantly exercise, have generally been found effective although many such studies were small, short-term, and not well controlled [14–16]. On the other hand, we are not aware of long-term studies of exercise which were not associated with reduction in disability [17]. Internationally, some populations studied over time have not experienced postponement of morbidity and some may have increased it, suggesting that while it is clearly possible to postpone morbidity under some circumstances [16], this result is not an inevitable one.

## 4. Longitudinal Studies of Disability: Runners Club versus Community Controls

We began our two longitudinal studies of aging in 1984 and 1986 and results have been reported formally every few years [18–23]. These studies were designed to directly test the hypothesis of compression of morbidity by lifestyle choices. Here, we describe these studies informally, and readers wishing study details should refer to the referenced papers. In this paper, we present new data including mortality rate trends beyond the median age at death and analyze mortality data out to 24 years of study. We are now able to directly compare postponement of morbidity and mortality in the same cohorts, and postponement of disability is greater than that of mortality.

The "Runners Study" began in 1984 with recruitment of 538 senior runners and 423 age-matched (average age 58) controls. Runners were deliberately recruited from the "50 Plus Runner's Club," for the most part jogged or ran over 2000 miles a year and were exercise enthusiasts. The control group was drawn randomly from the same community; about 25% of controls also ran recreationally, although they only averaged about 10% of the yearly distances logged by Runners Club members. Thus, the study allowed self-selection bias into the Runners cohort, conservatively included a very healthy control group. Analyses were focused in large part upon identifying, and if necessary adjusting for, selection biases [18–20].
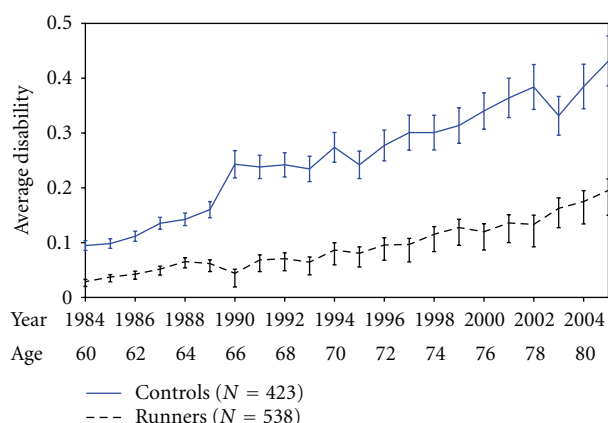
Figure 1: Average disability scores by age and calendar year, Runner's and community controls 1984–2005.

The design was intended to achieve as great a difference as possible between groups in the independent variable of interest. In this case, we wanted a large difference between the exercise group and the controls in "vigorous exercise minutes per week." We also wanted to create groups which were similar in educational attainment and income levels; lower levels of these socioeconomic factors are well known to be associated with poorer health and were potentially confounding variables for our study. Initial differences between groups in the exercise variable were tenfold, sufficient to dwarf possible confounders such as increased body mass index and cigarette smoking, which were rarely reported by either cases or controls. In analyses we also controlled for gender, ethnicity, physical injuries, family histories of arthritis, baseline X-rays for arthritis, chronic illnesses, whether they had ever run for exercise for a month or more, initial disability levels, and many other variables. Statistically adjusted data never differed significantly from raw data in any analyses. More complete discussion of these analytic issues may be found elsewhere [18–20].

Our primary analyses have been longitudinal study of the two original cohorts established in 1984. We also analyzed the "ever-runners" versus the "never-runners" cohorts formed in 1984 in order to exclude a bias where those who ran but stopped because of some physical difficulty and ended up in the control group; results were similar to those when we used the original runners and control cohorts but even more striking. Primary endpoints were between cohort differences on the horizontal axis over time rather than cross-sectional differences on the vertical axis (Figures 1–4). We sought to determine how long, if at all, disability was postponed in the Runners cohort compared with Controls [21].

Figure 1 shows disability levels [3] and 95% confidence limits from 1984 to 2005, comparing the Runners with the Controls. The Runners had slightly less disability at study onset in 1984, believed due to their prior 10 years (on average) of vigorous exercise. Over the years through an average age of 80, the differences in disability between the runners cohort and controls grew steadily greater and regression lines

continued to diverge ($P < 0.001$). The postponement of minimal (0.1 units) disability was 14 years over controls, and postponement of a higher disability level of 0.2 units was 16 years [3]. In other analyses, runners reported substantially less bodily pain and utilized substantially fewer medical resources [22]. In an X-ray subset, runners had a nonstatistically significant trend (4 versus 12) toward fewer knee replacements and totally destroyed (bone-on-bone) knee joints [19].

These findings were robust to statistical adjustments. We believe that developing cohorts with a large difference in the independent variable, exercise, materially strengthened these results. It was similar in design to choosing to study lung cancer incidence in 4-pack-a-day smokers versus non-smokers; the differences in lung cancer incidence would be very large and study would not require very many subjects to reach statistical significance. Of interest, about a third of runners in both cohorts discontinued running over the years. Reasons for discontinuation were generally social: the dog died, the subject moved to another climate, and running got boring. Essentially no one stopped running because of pain or arthritis. Almost all who stopped running continued other vigorous exercise through swimming, bicycling, brisk walking, or other activities. Thus, this is a study of regular vigorous activity rather than solely of long-distance running.

## 5. Longitudinal Studies of Disability: Risk Factors of Inactivity, Obesity, and Smoking

In the health risks cohorts (University of Pennsylvania) study, we have followed 1741 University of Pennsylvania attendees in 1939 and 1940 who were studied again in the College Alumni Study in 1962, and annually by our group beginning in 1986 at an average age of about 70 years. We formed three cohorts using data obtained in the College Alumni Study when they were in mid-life with an average of 43 years old. We did this to lock subjects into study cohorts with their mid-life health habits well before the media or the public knew much about these health risks, a conservative approach. Also conservative was to score only three health risks, arguably the most important ones, and to use simple sums of binary variables to define cohorts.

The risk factors were current smoking, body mass index (BMI) 25 or higher (overweight), and absence of vigorous physical activity (inactivity), including jogging, brisk walking, and other activities which resulted in a sweat, all as measured at age 43. The risk factor score was based upon low risk (no risk factors), moderate risk (1 risk factor), and high risk (2 or 3 risk factors). Thus, the risk score used to define the three cohorts was a priori, arbitrary, and simple, and did not permit "data mining" of baseline scores of multiple variables to bias results. Some study power was probably lost through use of a simple index, but objectivity was increased and, as it turned out, there was plenty of statistical power. Study details may be found in previous reports [21–23].

The dependent variables were mortality and morbidity (disability), as measured in the Runners study, at yearly intervals. The plan here was to begin with cohorts about 10 years older than in the Runners study so as to study
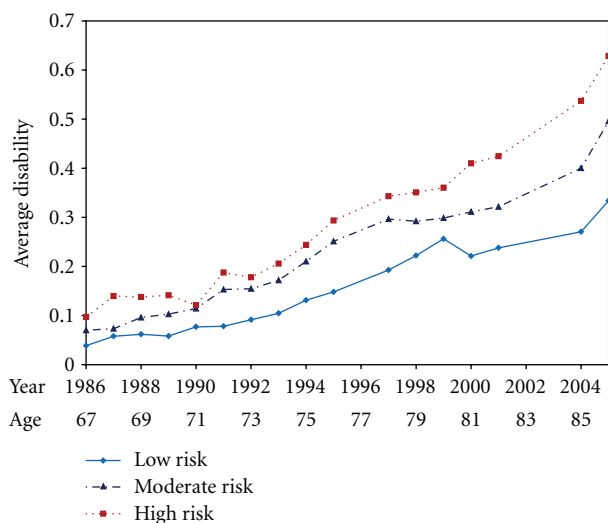
FIGURE 2: Average disability scores by age and calendar year, University of Pennsylvania Study 1986–2005.



FIGURE 3: Kaplan-Meier analysis, Runner's and community controls 1984–2009.

aging effects at higher ages, to use college classmates so that entry ages were clustered, and to select university alumni as a means to reduce confounding by poverty and other social disadvantage, as well as to maintain good follow-up rates and accurate reporting. Subjects were not aware of their membership in a particular cohort [23].

Figure 2 shows disability scores by age and by calendar year for the three cohorts from 1984 to 2005. The risk factor cohorts of low (0 risk factors), moderate, (1 risk factor), and high risk (2 or 3 risk factors) had initial scores in the postulated order, where the low risk cohort had less initial disability than the moderate risk cohort, which had less than the high risk cohort. Initial disability levels were all close to zero, however, and baseline effects were small. Disability levels and differences between cohorts increased monotonically over time. At last observation in 2005, high-risk subjects were about twice as disabled as low risk. Similar results obtained when we looked at cumulative disability, those living, those who had died, and men and women, and when we adjusted for covariates [23].

A disability score of 0.3 units (moderate disability) was postponed by 10 years in low-risk subjects compared with high risk. Since there were also differences in mortality, which was highest in high risk, noncompleters due to death were occurring particularly in the high-risk subjects with the very highest risks, acting against the primary findings. Attrition other than by death did not differ between cohorts. The relative contribution of each of the three risk factors was difficult to estimate because of autocorrelation of the risk factors [23].

## 6. Longitudinal Studies of Mortality: Runners versus Controls

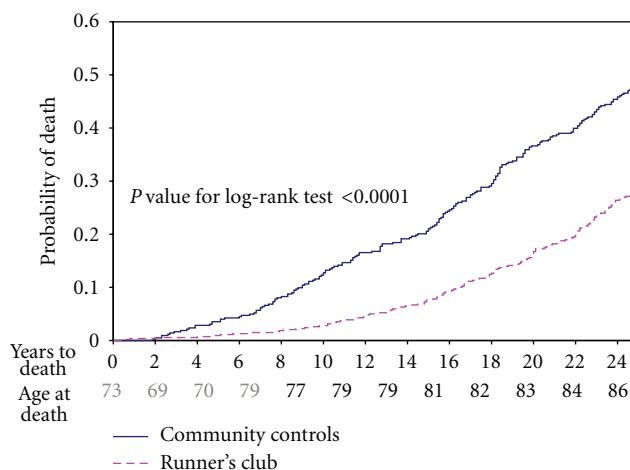In our study of runners and controls we have complete mortality data confirmed by the National Death Index from 1986 through 2009, a period of 25 years [18]. Two hundred and seven controls, out of 423 (48.9%) had died, compared with 164 out of 538 in the runners cohort (30.5%). Thus, we are able to compare differences between cohorts at the level where at least 30 percent had died in each cohort, but not at the median.

Figure 3 displays a life table comparison of the two cohorts. The runners had only 25% of the mortality rates of the control group over the first eight years, but there was subsequent convergence as subjects aged so that at year 25 the runners have 60 percent of the mortality rate of the Controls. Over the most recent five years the mortality curves are parallel or even closing slightly [18]. Median death for the controls is about 83 years of age; median age at death cannot yet be estimated for the exercising group but will be higher.

There are differences in the morbidity and mortality outcome variables in that mortality is binary with a metric of years to death, while morbidity (disability) is considered as a continuous variable scored from zero to three, usually with a monotonically upward trend in the individual once nonzero disability has been noted. It is difficult to estimate these outcomes validly until most subjects have died in all cohorts and one can compare median values. In Figure 3, the postponement of mortality is about 7 years in the runners at last observation, but this difference seems likely to close during the age period of 83 to 93 years by which time most of the subjects in each cohort will have died. Postponement of morbidity (Figure 1) is 14 to 16 years. Spousal validation studies did not reveal questionnaire or interview responses of morbidity of either runners or controls to be biased in either direction [18–23].

## 7. Longitudinal Studies of Mortality: Health Risk Factors

The low risk (no risk factors), moderate risk (1 risk factor), and high risk (2 or 3 risk factors) cohorts had overall mortality of 60%, 65%, and 72%, respectively in 2009, so
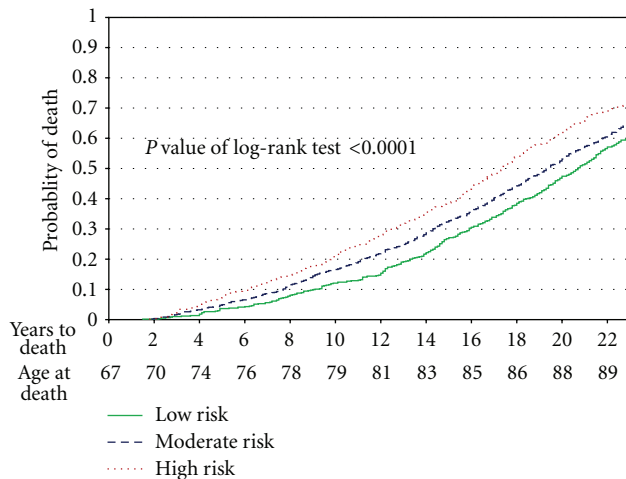
Figure 4: Kaplan-Meier analysis, University of Pennsylvania 1986–2009.

that all cohorts had passed the median death and all had at least reached the 60% mortality level. Figure 4 shows Kaplan-Meier survival curves for these cohorts. Differences favoring the low-risk cohort tended to diverge increasingly from the high-risk cohort over the first 12 years and then to stabilize and to slightly converge subsequently.

Postponement of mortality is seen more clearly here than in the Runners study since a greater fraction of subjects have died. We estimate this difference by measuring the horizontal difference between the high- and the low-risk groups at each decile mortality line which meets or crosses all three curves (0.1–0.6). At last observation, mortality postponement is about 3.5 years, and it has been three to four years throughout. The median death occurred about 3.7 years later in the low-risk group as compared with the High risk [21, 23]. Using linear regression analyses to smooth the curves, postponement of death is 3.3 years in low risk versus high risk, with moderate risk always intermediate. This postponement was 2.5 years in men and 4.0 years in women.

Our estimates of postponement of disability in the two studies thus range from 10 to 16 years, and postponement of death ranges from 3.3 to 7 years. These results are specific to these risk factor distributions and these patient cohorts. The data, replicated by these parallel studies and backed by the general literature, suggest that exercise improves health, that nonsmoking is a healthy habit, and that a normal body weight is good for you, both in terms of mortality and also in terms of cumulative lifetime disability and other life quality measures. They suggest that postponement of disability absent these risk factors is several-fold the postponement of mortality and thus that the onset of disability draws closer to the age at death, compressing morbidity between a 10- to 16-year later onset and only a 3.3- to 7-year postponed age at death [21].

Contrasting the two studies, effects are similar for both mortality and morbidity, but the differences are less in the health risk cohorts than in the runners. These results suggest

that lack of exercise may be the most important risk factor of them all, particularly in nonsmokers. However, the Runners study had a very large difference in the independent variable, vigorous physical exercise, by design. The risk factor cohorts were derived from a more homogeneous population with lesser differences in the prevalence of risk factors between cohorts.

## 8. Population Studies of Morbidity

Another major effort to test the Compression hypothesis has involved population studies over time. In the United States, two premier population studies in the United States were begun shortly after the Compression of Morbidity hypothesis was raised. The National Long-Term Care Survey (NLTCS) [24, 25] studied Medicare eligible subjects 65 years old and older whether institutionalized or community-living (1982–2004) and the National Health Interview Study (NHIS) noninstitutionalized individuals over age 70 (1982–1999) [26]. Disability in the NLTCS declined 1.27% over the entire period and 2.1% in the last five years. NHIS had similar results, as did the next five studies as ranked by quality [27]. Mortality rates declined nationally about 1% per year over this period [28]. This documents the possibility of Compression of Morbidity on a national basis. It should be noted that not all studies have shown morbidity compression, particularly some European studies, and there has been speculation, and a little data, suggesting that the current obesity epidemic might reverse improvements of the prior two decades; the data presented here in the Risk Factor study could be considered to support this possibility. Unfortunately, the NLTCS had its last survey cycle in 2004, and more recent data from other sources cannot be directly compared to the NLTCS because of multiple changes in sampling designs and outcome variable definitions.

Population studies, because of their broad reach and policy implications, are of great value. Nevertheless, they are not particularly sensitive to change, and they generally offer little insight into the causes of the changes. National mortality and morbidity rates are influenced by economic cycles and offsetting trends in risks, as in rising population obesity and declining population cigarette smoking. They do not necessarily reflect a coherent population trend in health risks. It is not surprising that different countries have reported different trends, some of which differences do not appear to be attributable to methodology [29].

These studies provide proof-of-concept, in that the best studies since 1982 in the United States show convincing rates of Compression of Morbidity [30]. But, Compression of Morbidity, almost a necessity for progress in health improvement, clearly has not occurred in all populations and all subgroups [31].

## 9. Need and Demand Reduction

The Compression paradigm is central to health policy issues. If Compression of Morbidity occurs, it seems likely that the medical care burden would also go down. Costs of chronic diseases in senior citizens are a large driver of medical

costs. Medical care costs are threatening the viability of the economy. Disability is a strong predictor of medical costs [32–34]. Health promotion programs which reduce senior health risks, as studied with large randomized trials, can reduce health risks and also reduce costs [11, 12, 32]. The policy formulation "reduction in need and demand for medical services," suggests an approach to reducing medical care costs by reducing the illness burden and thus reducing the need for medical services [33, 34]. The "demand" side reflects a population tendency to desire the new and the expensive rather than the older and traditional.

Medical need theoretically may be moderated by improved lifestyle choices as described here, as well as use of medical self-care, hospices, advance directives, and other low-cost interventions. The Centers for Medicare and Medicaid Services currently is studying the role of interventions directed at the twin goals of improving health and reducing costs, and preliminary results of a large randomized multiyear study of such interventions in Medicare populations should be available soon [35]. The "Compression of Morbidity" is an important theoretical approach to both health improvement and medical care cost reduction [36].

## 10. Trajectories of Morbidity: The Algebra of Health

Another promising research agenda involves study of the discrete trajectories which collectively describe overall health outcomes in a population. Many factors other than personal health risks affect both population mortality and morbidity, and a current challenge is to catalog the positive or negative effects of such factors upon mortality and morbidity. In addition to health risk reduction and its association with compression of morbidity, other potential factors include safer cars, super highways, seat belts, neighborhoods, ethnicity, prompt treatment of stroke, hypertension control, glucose control, cholesterol control, total joint replacement, HIV/AIDS, gang murder, and suicide before mid-life.

Moreover, there are subsets of disease conditions that result in opposite trajectories, as with fatal and nonfatal heart attacks, fatal and non-fatal strokes, or resectable versus nonresectable cancer. For example, coronary artery disease has a trajectory of sudden mid-life death as the first symptom, a trajectory of sudden death with first symptom at an advanced age, a trajectory of multiple acute coronary events, and a trajectory of slow progression of chronic congestive heart failure.

The effects of coronary artery disease on the national morbidity and mortality thus require descriptive information on the several trajectories, the incidence of each, and the algebraic sum of trajectories as the impact of the disease condition. Deconstruction of the possible trajectories of a disease is followed by reconstruction. Presently available data as to the direction and magnitude of effect of disease trajectories permits conjecture but not conclusion [21, 36, 37]. Future advances in health assessment and health policy will require detailed study of the different trajectories of the same disease.

The new paradigm of "Active Aging" or "Compression of morbidity" aspires to improve human health. There is proof-of-concept. Future population health improvement will require theory, science, and strategy and will involve multiple disciplines of inquiry.

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*Research Article*

# Prevalence of Successful Aging in the Elderly in Western Mexico

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*Objectives.* The aim of this paper is to estimate the prevalence of successful aging in the elderly in Western Mexico and to analyze its variability by age, sex, education, marital status, and pension. *Methods.* This study employs data from the Health, Wellbeing, and Aging Study (SABE) in Jalisco and Colima, Mexico. Successful aging was operationalized in accordance with no important disease, no disability, physical functioning, cognitive functioning, and being actively. There were a total of 3116 elderly. *Results.* 12.6% of older adults were "successful" aging. The old-old is a lower proportion of successful aging people; it ranges from 18.9% among people aged 60–69 years to 3.9% in the 80–89 years and up to 1% in people 90 and older. There were also differences according to sex ($P = .000$), with a higher proportion of successful aging men (18.4% compared with 9.2% of women). There were differences in educational level ($P = .000$); those higher with education were found to be more successful aging, and also there were differences in marital status for married people ($P = .000$). *Discussion.* A small number of older adults meet the criteria definition of successful aging, suggesting the need to analyze in depth the concept and the indicators.

## 1. Introduction

The increase in the relative and absolute number of older people in our society has posed a major challenge for both individual and collective levels in the study of aging. It had appeared various contributions, at the individual level, extending the biological perspective of disease and disability with a more positive and comprehensive one, covering the social and behavioral sciences to reduce the risk of adverse events and improve the resilience of the seniors and make changes in their immediate surroundings [1].

At the population level, aging is seen as a challenge that involves, in addition, as stated by Fernandez-Ballesteros [2], challenges such as the double burden of disease, increased risk of disability, having to provide adequate care for the aging population, addressing inequalities, economic challenges, and having a different view of aging and old age.

In industrialized countries, demographic and social changes of the population have brought into discussion the approach of public policies on aging related to pensions, employment, health social care, and protection of citizenship. In this context emerges a new paradigm that implies a new vision of aging, a positive vision, called "active aging". *The WHO has considered that Active Ageing is the key if it is wanted to make aging a positive experience and free of disability, with ongoing opportunities for health, participation and security especially in increasingly aging societies like ours* [3].

The concept of active aging emphasizes the vital connection between activity and health since it considers active aging in terms of health, independence, and productivity of older people. It also incorporates key principles to meet the policy domains required to successfully meet the challenges of an aging population: the activity, prevention, inclusion of all older people, maintenance of intergenerational solidarity, rights and obligations, participation and empowerment of the people, and respect for national and cultural diversity (for review, see Alan Walker [4, 5]).

Alan Walker [5] performed an important review of the theoretical foundations of the term active aging and explains that the use of it is much older in the United States, dating back to the 1960s, [6] initially taking the name of "successful aging" is to keep in the old age the same activity patterns and values typical of the middle age.

Regarding this issue, Rowe and Kahn [1, 7, 8] made an important contribution, with a theoretical model of "successful aging" at the individual level covering three different areas: preventing disease and disability, maintaining high physical and cognitive function, and to having a sustained commitment to social and productive activities. This model has been widely used as a tool to describe the aging of the elderly; [9–21] however, as aging is a dynamic process it may vary over time by the influence of the social, economic, and political dimensions [22, 23].

In this study we will use the model of Rowe and Kahn on successful aging considering that active aging encompasses both macro- and microstructural dimensions and that, occurs over time as active aging leads to successful aging.

This model considers that there are different forms of aging: usual, pathological, and successful. Fernandez-Ballesteros [24] mentions that successful aging can be considered as a categorical variable that can estimate prevalence in the population.

The aim of this paper is to estimate the prevalence of successful aging in the elderly in western Mexico as defined by Rowe and Kahn and analyze its variability by age, sex, education, marital status and pension.

## 2. Methods

*2.1. Population and Procedures.* This study employs data from the Health, Wellbeing, and Aging Study (SABE) in Jalisco and Colima, Mexico. It is a cross-sectional study proposed for Latin American population by the PAHO; it consists in a protocol to assess health, functionality, nutritional, cognitive, emotional, and social aspects of elderly [25]. A total of 3,116 elderly persons were included in a multistage, proportional, and randomized sample that included the states of Jalisco ($n = 1596$) and Colima ($n = 1520$) (in western Mexico). Maps and databases of potential populations were consulted. To carry the survey out in the geographical area, study areas were defined through the National Geo-statistic Framework (INEGI). Basic Geo-statistical Areas (*AGEBs*) were chosen randomly, and the same was done for regarding blocks and homes until finding the study subjects. Persons 60 years and older were invited to participate in the study. Characteristics of the study participants are shown in Table 1; 15.8% of people had cognitive impairment, which was requested an informed as suitable to respond to the interview. Ethical approvals in both states and informed consent or relative agreement were obtained.

*2.2. Dependent Variable.* Based on the conceptualization of Rowe and Kahn [1] of successful aging and studies by Strawbridge et al. [19] and McLaughlin et al. [22] successful aging is defined as having (a) no important disease, (b) no disability in activities of daily living (ADLs), (c) no more than one difficulty of seven measures of physical functioning, (d) cognitive functioning, and (e) being actively engaged. (for review, see McLaughlin et al. [22], SABE study included same indicators in the survey).

*No Important Disease.* Participants in SABE study were asked that if ever a doctor or nurse has told them to have each of the following five chronic diseases: cancer, chronic lung disease, diabetes, heart disease and stroke (for this analysis hypertension and articulate disease were excluded). We have also included a measure of mental health as McLaughlin refers [22], in the SABE study, we applied the Geriatric Depressive Screening scale (GDS) with scores ranging from 0–15. We considered subjects with high depressive symptoms those with a score >5. To meet the criteria of "lack of serious illness", respondents could not have any of the five chronic diseases and depressive symptoms as classified [26].

*No Disability.* Respondents who reported no difficulty performing each of the six basic activities of daily living ADLs (i.e., walking across a room, dressing, bathing or showering, eating, getting in or out of bed, and toileting) met the criterion of no disability [12, 19].

*Physical Functioning.* Participants were classified as with high physical functioning if did not reported more than one difficulty with any of the following seven measures, including walking one block, walking several blocks, climbing up one floor of stairs, climbing several floors of stairs, lifting or carrying the items weighing more than 10 pounds, stooping, kneeling, stooping or squatting, and pulling or pushing big objects. The SABE survey measures are identical to the study of McLaughlin et al. [22] which has its background in Seeman et al. [13].

*Cognitive Functioning.* Cognitive impairment was measured using the Mini-Mental State Examination of the SABE protocol [27]. The MMSE score was calculated using the sum of correct answers (0–19 points), the cutoff point was 12/13.

*Being Actively Engaged.* It refers to social connections and participation in productive activities [1, 8]. For this analysis, it is defined as "actively participate" if the participant reported doing any paid work during the last week from the interview, or any volunteer work, family, home or selling on their own. In addition to reporting any of these social connections: being married or living in company with a relative or friend, and if participants attend religious celebrations often.

*2.3. Independent Variables.* Age, gender, education, marital status, and pension were included in the analysis. Age was categorized as 60–74 years and 75 and older. Education was categorized as less than high school and secondary or higher education level.

*2.4. Analytic Techniques.* The prevalence of successful aging was calculated by age, gender, education, marital status, and pension. To determine if sociodemographic differences were statistically significant, the adjusted odds ratio (OR) and 95% confidence intervals (CIs) were calculated. The independent associations between age, sex, education, marital status and pension, and successful aging were evaluated by binary

Table 1: Socio-demographic Characteristic by Sex.

| Characteristic | Women % (n) | Men % (n) | Total % (n) |
|---|---|---|---|
| Sex*** | 62.5 (1949) | 37.5 (1167) | 100.0 (3116) |
| Age, years*** | | | |
| 60–69 | 45.6 (889) | 37.8 (441) | 42.7 (1330) |
| 70–79 | 34.0 (662) | 39.4 (460) | 36.0 (1122) |
| 80–89 | 17.4 (340) | 19.2 (224) | 18.1 (564) |
| 90+ | 3.0 (58) | 3.6 (42) | 3.2 (100) |
| Education (level)*** | | | |
| Did not attend school | 21.0 (409) | 19.5 (228) | 20.4 (637) |
| Less than high school | 59.0 (1150) | 53.6 (626) | 57.0 (1776) |
| High school or higher | 20.0 (390) | 26.8 (313) | 22.6 (703) |
| Marital status*** | | | |
| Married | 45.9 (894) | 71.5 (834) | 55.5 (1728) |
| Widowed/separated/ divorced | 46.4 (904) | 24.5 (286) | 38.2 (1190) |
| Never married | 7.7 (151) | 4.0 (47) | 6.4 (198) |
| Pension*** | | | |
| Yes | 9.4 (184) | 41.0 (478) | 21.2 (662) |
| No | 90.6 (1785) | 49.0 (689) | 78.8 (2454) |

***$P = .000$.

Table 2: Percentage of older adults meeting each individual successful aging criterion and total percentage.

| Criteria | Women % (n) | Men % (n) | Total % (n) |
|---|---|---|---|
| No major disease | 40.1 (761) | 42.5 (484) | 41.0 (1245) |
| No disability | 73.1 (1414) | 76.1 (884) | 74.2 (2298) |
| Cognitive functioning* | 83.0 (1617) | 86.4 (1008) | 84.2 (2625) |
| Physical functioning*** | 33.0 (643) | 49.8 (581) | 39.3 (1224) |
| Social engagement*** | 43.2 (842) | 57.3 (669) | 48.5 (1511) |
| Successful aging*** | 9.2 (179) | 18.4 (215) | 12.6 (394) |

*$P = .01$ ***$P = .000$.

Table 3: Successful aging by age, sex, education, marital status and pension.

| Variable | Successful aging % (n) | No Successful aging % (n) | $P =$* |
|---|---|---|---|
| Age (years) | | | |
| 60–69 | 18.9 (251) | 81.1 (1079) | |
| 70–79 | 10.7 (120) | 89.3 (1002) | .000 |
| 80–89 | 3.9 (22) | 96.1 (542) | |
| 90+ | 1.0 (1) | 99.0 (99) | |
| Sex | | | |
| Women | 9.2 (179) | 90.8 (1770) | .000 |
| Men | 18.4 (215) | 81.6 (952) | |
| Education (level) | | | |
| Did not attend school | 5.8 (37) | 94.2 (600) | |
| Less than high school | 12.4 (220) | 87.6 (1556) | .000 |
| High school or higher | 19.5 (137) | 80.5 (566) | |
| Marital status | | | |
| Married | 19.9 (344) | 80.1 (1384) | |
| Widowed/separated/ divorced | 2.9 (35) | 97.1 (1155) | .000 |
| Never married | 7.6 (15) | 92.4 (183) | |
| Pension | | | |
| Yes | 13.9 (92) | 86.1 (570) | .093 |
| No | 12.3 (302) | 87.7 (2152) | |

* Chi-square test.

logistic regression analysis (confidence intervals by exp $\beta$ of 95%).

## 3. Results

Table 1 shows the sociodemographic characteristics of participants. The mean age was 72.41 (SD = 8.47) years, the majority of participants were women (62.5%). Regarding education, 20.4% were illiterate, 57.0% had less than secondary education, and only 22.6% more than high school. Most of the elderly were married (55.5%) and 6.4% never did so. Only 21.2% had pension.

While comparing the sociodemographic characteristics by gender we see that 45.6% of women were between 60 and 69 years old as opposed to 37.8% of men, this difference affects the average age where women obtained $72.0\pm8.54$ and 73.0 men $\pm 8.33$ years.

At the same time, men mentioned higher levels of education than women, for example, 26.8% of men have high school or higher level of education, while on the other hand only 20.0% of women have it. Regarding to marital status, 71.5% of men claimed to be married or cohabiting, while only 45.9% of women did. These gender differences are more marked on the pension, as only 9.4% of women report receiving pension compared with 41.0% of men.

The ratio of participants meeting the criteria of successfully aging was calculated, the results are shown in Table 2. As it can be seen, a higher percentage met the criteria of cognitive functioning (84.2%), men (86.4%) in greater proportion than women (83.0%), and no disability (74.2%),

while 41.0% and 39.3% met the criteria of nondisease and physical functioning, respectively. The latter with significant differences by sex (33.0% women and 49.8% men).

The criterion of social commitment was met by 48.5% of the participants; women also had lower percentage (43.2%) than men (57.3%).

Altogether, 12.6% of the participants met all the criteria to be considered as successfully aging. When comparing among successfully aged elderly (see Table 3) significant differences ($P = .000$) according to age were found. In older age there is a lower proportion of active aging people, it ranges from 18.9% among those between 60–69 years to 3.9% among those between 80–89 years and up to 1% in people 90 and older. There were also differences according

TABLE 4: Crude and adjusted odds ratio for successful aging.

| Variable | Successful aging (%) | Crude OR (95% CI) | P = | Adjusted OR* (95% CI) | P = |
|---|---|---|---|---|---|
| Age, years | | | | | |
| ≥75 | 5.2 | 0.30 (0.23–0.39) | .000 | 0.35 (0.26–0.47) | .000 |
| 60–74 | 17.0 | | | | |
| Sex | | | | | |
| Women | 9.2 | 0.50 (0.41–0.60) | .000 | 0.52 (0.41–0.66) | .000 |
| Men | 18.4 | | | | |
| Education | | | | | |
| ≤high school | 10.7 | 0.55 (0.45–0.66) | .000 | 0.58 (0.45–0.75) | .000 |
| >high school | 19.5 | | | | |
| Married status | | | | | |
| No | 3.6 | 0.18 (0.13–0.24) | .000 | 0.20 (0.14–0.27) | .000 |
| Yes | 19.9 | | | | |

Notes: adjusted for age, sex, education and marital status.
OR: odds ratio, CI: confidence interval, *binary logistic regression.

to gender ($P = .000$), with a higher proportion of men aged successfully (18.4% compared to 9.2% of women). In the same way, differences in educational level ($P = .000$), whereas education level increasing more active aging was found, and also differences in marital status for married people ($P = .000$). There were no differences according to whether receiving pension or not ($P = .093$).

Finally crude and adjusted odds ratios and confidence intervals for successful aging were calculated, the results are shown in Table 4.

As seen in the unadjusted analyses, 30.0% of adults of 75 or more years had the possibility of successful aging compared to the group of 60 to 74 years, OR = 0.30 (0.23 to 0.39, CI 95%). Women had 50.0% less successful aging than the observed in men, OR = 0.50 (0.41 to 0.60, CI 95%). Participants with lower education had only 55.0% successful aging compared to those with higher education, OR = 0.55 (0.45 to 0.66, CI 95%).

Finally, the elderly that at the time of the interview were not married or cohabiting had only 18% of successful aging compared to those who were married, OR = 0.18 (0.13 to 0.24, CI 95%). After adjusting for sociodemographic factors (age, sex, education and marital status) these four are held as factors in the model of successful aging. The adjusted odds ratios are slightly higher than the unadjusted.

## 4. Discussion

In this study the prevalence of successful aging was 12.6%. Mexico is currently in the process of demographic transition towards an aging population, even though the life expectancy is lower than that in developed countries. It is not known whether in Mexico there are other studies that estimate the prevalence of successful aging or not, so the comparison of our results with studies from developed countries is flat and should be viewed with caution, given the differences in the age structure of aging population and the social and economic conditions.

Other active aging studies that were based on the criteria of Rowe and Kahn found 18.8% [19] and 11.9% to 10.9%

[22] of prevalence of successful aging. Several review studies have found a large variability in the indicators that have an influence on how the prevalence of successful aging is defined, having a direct effect on the reported figures. For example, Depp and Jeste [28] reviewed 27 studies where besides defining the concept operationally, they established the prevalence of successful aging and found a range that varied from 0.4 to 95%. In a similar review study by Peel et al. [29] 18 studies that included definitions of successful aging were analyzed and it was found that the prevalence established in these studies ranged from 3% to 80%. With this, it can be established that the nature of definitions, domains, and selected measures results in considerable variation in the proportion of the population classified as successful aging. Overall, we had a low nonparticipation rate estimated in 8.67%. The population study consisted of a greater number of women (62.5%) than men (37.5%) with an average age less than men. The reason could be because the interviews were conducted in homes, and men, particularly the younger, still have a working life.

Regarding gender, in this study it was found that more men than women meet the criteria of Rowe and Kahn's successful aging. This is a controversial finding, since other studies have found opposite trends where more women than men have higher prevalence of successful aging. For example Strawbridge et al. [19] reported significant differences when finding that 21.5% of women and 15.4% of men met the criteria for successful aging, while McLaughlin et al. [22] found a trend towards men but not significant one. However, we think that in our female population the prevalence is consistent with the data, as these are seen as linked to lower cognitive and physical function as well as less social and productive participation. Also, it is observed in women a lower level of education, a significant number of widows, and almost no pension (9.4%).

The results regarding the relation between age and level of education with successful aging are more consistent in the sense that as age increases, the percentage of people with successful aging decreases, while higher education prevalence of successful aging among the population increases significantly.

A limitation of this study is that some of the criteria for successful aging are based on self-referrals of both health status and physical activity. However, the criterion of cognitive function was actually evaluated and in some way helps to ensure that the classification is not based only on subjective judgments. In the same way, the assessment of depressive symptoms was performed using a validated scale.

It is also necessary to consider that 15.8% of the sample had cognitive impairment and was asked to perform a key informant interview. Thus, this study found 84.2% of cognitive function, similar to the numbers found in a study of prevalence of cognitive impairment in Jalisco population, estimated in 85.5% [30].

Regarding no disability estimated in 74.2%, it was found in our population a lower percentage of no disability than the other seven populations of Latin American cities, in the SABE study, who ranged from 76.3%–86.2% of no disability [31].

Another limitation is that our study is about prevalence so that the associations are horizontal and do not allow the establishment of predictors. However, this is a first approach that contributes to the characterization of the Mexican population around the concept of successful aging.

## 5. Conclusions

This study presents a research on the prevalence of successful aging in elderly in western Mexico. A small number of elderly met the criteria of Rowe and Kahn definition of successful aging, so more effort is required in the individual and collective levels to improve the health, economic, and social participation conditions, as well as greater efforts to establish public policies in accordance with the principles of active aging in different dimensions from the macro-, meso- and microstructural that include people of all ages, so that different generations can age actively and achieve successful aging.

Regarding the criteria for successful aging, Rowe and Kahn proposal includes biological, psychological, and social aspects, which gives the desired multidimensionality at an individual level to define successful aging. However, it is in the operationalization and the establishment of indicators where more efforts should be done to reach consensus and achieve comparative studies to reach with it more consistency.

## Acknowledgments

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*Research Article*

# Social Determinants of Active Aging: Differences in Mortality and the Loss of Healthy Life between Different Income Levels among Older Japanese in the AGES Cohort Study

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We examined the relationship between income, mortality, and loss of years of healthy life in a sample of older persons in Japan. We analyzed 22,829 persons aged 65 or older who were functionally independent at baseline as a part of the Aichi Gerontological Evaluation Study (AGES). Two outcome measures were adopted, mortality and loss of healthy life. Independent variables were income level and age. The occurrence of mortality and need for care during these 1,461 days were tracked. Cox regressions were used to calculate the hazard ratio for mortality and loss of healthy life by income level. We found that people with lower incomes were more likely than those with higher incomes to report worse health. For the overall sample, using the governmental administrative data, the hazard ratios of mortality and loss of healthy life-years comparing the lowest to the highest income level were 3.50 for men and 2.48 for women for mortality and 3.71 for men and 2.27 for women for loss of healthy life. When only those who responded to questions about income on the mail survey were included in the analysis, the relationships became weaker and lost statistical significance.

## 1. Introduction

There is a well-established inverse relationship between income and health [1–7]. However, many of the studies reporting on this relationship have used mortality as an indicator of health. In evaluating health, the World Health Organization recommends using indicators that reflect quality of life (QOL), such as healthy life expectancy, which measures active aging. Active aging aims to extend healthy life expectancy and quality of life in older persons, and the quality of life is largely determined by its ability to maintain autonomy and independence [8]. Fewer studies use active aging as an endpoint because these measures, unlike measures of mortality, require investigation into the physical and cognitive functioning of surviving participants. As a result, in large-scale cohort studies it is much more difficult and costly to follow functional status over a long period than to simply follow mortality.

Measuring income is a difficult issue in studies that investigate the relationship between income and health. Individuals with lower socioeconomic status (SES) tend to be less likely to respond to surveys by mail or similar means. In addition, income data are often unreliable or missing for a large part of the sample [9]. Therefore, lower income groups, which are predicted to be the least healthy, are not well represented. This underrepresentation gives rise to the possibility of underestimating the inequality in health. However, while this problem has been acknowledged, there are no studies that have compared analyses using government statistical data, which have almost no missing data, and analyses of survey respondent data to investigate the existence and size of underevaluation of the income inequality.

Fortunately, we have been able to overcome the issues involved in conducting a large-scale cohort study that monitors functional status and obtaining income data from both surveys and local government statistics. The Japanese

government introduced a public long-term care insurance system in 2000. Insurance applicants are assessed using standard criteria for physical and cognitive functioning to determine eligibility. Long-term care insurance premiums are imposed on everyone 65 years of age or older who is insured under the long-term care insurance system. These premiums are set according to income level, which is determined by the municipality in which the insured person lives.

In this study, we used representative sample data of five municipalities that contains information on physical and cognitive functional declines and income data from the government to examine the relationship between health and income. In addition, we conducted a survey by mail, and using this government data and data on responses to income items in the mail survey, we investigated the effect of differential response in income self-reports among the elderly.

Measuring the inequality in health using Japanese data is also thought to be meaningful in other ways, as the healthy life expectancy in Japan is among the longest in the world [10]. In addition to background factors, such as improved medical services and dietary habits that come with universal healthcare and economic growth, the equitableness of Japanese society, with small inequalities among people, has attracted attention as a possible reason [11, 12]. In a recent meta-analysis, health levels are reported to be lower among people living in countries with a large Gini coefficient and very unequal income distributions [13].

However, since the 1990s, the Gini coefficient has been rising in Japan as the income inequality has widened. There is concern that in the coming years the inequality in health will continue to grow in Japan, making it similar to other developed countries. However, there are particularly few investigations on the relationship between income and health in Japan. Moreover, most of the studies that have been conducted on this subject are ecological studies, such as the studies by Fukuda and colleagues [14, 15] that show a relationship between income level and mortality in communities. The only cohort study that we are aware of was conducted by Kimura and colleagues [16]. This study demonstrated an association with mortality using scores (0–6) prepared from six dichotomous indicators related to income. No studies have investigated the relationship between quantitative income and health at the individual level [17].

## 2. Objectives

The purpose of this study was to investigate the relationship between health and income using a prospective cohort study design. The investigation was dually focused and included (1) an investigation of the relationship between mortality and income and loss of healthy life and income; (2) a comparison of responders of a self-administered mail survey to a sample of elderly people, including those who did not respond to the survey, to investigate differences in the income-health relationship in the two samples.

## 3. Materials and Methods

### 3.1. Study Population.
The present study is based on data from the Aichi Gerontological Evaluation Study Project. The project is an ongoing prospective cohort study that started in two municipalities in Aichi Prefecture, Japan, in 1999. The project focuses on elderly people aged 65 years and older who are independent in physical and cognitive functioning. In second wave surveys of this project, research results are being accumulated with a focus on cross-sectional data obtained in fiscal 2003 from 15 municipalities in three prefectures [18–21]. Currently, follow-up data on certification of long-term care need and mortality are being obtained for the municipalities that cooperated in this study and from among the municipalities that are the subjects of second wave surveys. There are several published articles using this cohort data [22–24].

The present study looked at elderly people 65 years of age or older living in five municipalities that provided income data. Ethical approval for the study was obtained from the Nihon Fukushi University ethics committee.

### 3.2. Participants.
Self-administered questionnaires completed by elderly people 65 and older living in one of five participating municipalities were collected by mail in October 2003. The questionnaire included items that asked about the physical, mental, and social situation of respondents. Of the 24,374 people selected to receive the survey by the municipalities, those who had been certified as needing long-term care as of October 31, 2003 were excluded, and the remaining 22,829 people were included as subjects in the present analysis. The mean age $\pm$ SD of the subjects was $73 \pm 6.3$ years, and there were 10,290 men and 12,593 women.

The age and income level distribution of the entire sample is shown in Table 2. The standards were the same for men and women, but the distribution for men and women differed. More than 20% of men were in the fifth level and more than 50% were in the fourth and fifth levels combined. In comparison, less than 10% of the women were in the fourth and fifth levels combined. Here are some reasons for the gender difference in income. First, the greater part of Japanese women was full-time housewives. Full-time housewives were not obliged to enroll in the national pension scheme until 1985, so some part of them had not participated in the national pension and they receive lower pension benefits. Second, the percentage of older women living alone exceeds that of men. According to the 2000 national census, the living alone rate for older women is 17.9 percent, compared to 8.0 percent for men. Single households have considerably lower household income than other household type. Table 3 shows the number of people and percentage that responded to the survey and to questions about income by age and income level. There was a tendency for both men and women in high income groups to have a high response rate.

Table 1: Income level.

| Income level | Eligible persons | Premium |
| --- | --- | --- |
| Level 1 | Public assistance recipients<br> Municipal tax-exempted households and old-age welfare<br>Pension recipients | Basic amount × 0.5 |
| Level 2 | Municipal tax-exempted households | Basic amount × 0.75 |
| Level 3 | Municipal tax-exempted persons | Basic amount × 1 |
| Level 4 | Municipal tax payer (the insured person's total amount of income is less than 2,500,000 yen) | Basic amount × 1.25 |
| Level 5 | Municipal tax payer (the insured person's total amount of income is 2,500,000 yen or more) | Basic amount × 1.5 |

### 3.3. Measures

*3.3.1. Dependent Variables.* Two outcome measures were adopted, mortality and loss of healthy life. Data were collected from the public long-term care insurance database maintained by each participating municipality. Mortality was ascertained using the insured person list of the public long-term care insurance. Loss of healthy life was defined as mortality, functional decline, or cognitive impairment. The condition of "functional decline or cognitive impairment" means a condition assumed to require care on a continual and steady basis for the whole or a part of basic movements in daily activities. Functional decline or cognitive impairment assessed using standards presented by the national government, an examination of mental and physical status based on a visiting survey to maintain objectivity and reliability and make a screening judgment based on the opinions of a regular doctor [25].

*3.3.2. Independent Variables.* Income level was based on calculations used to determine long-term care insurance premiums, since long-term care insurance premiums in Japan are determined based on income level (Table 1). Subjects who are exempt from the municipal residence tax earn an income of less than 1.25 million yen according to criteria set in 2003.

*3.3.3. Statistical Methods.* The study sample were followed from November 1, 2003 to October 31, 2007. The occurrence of mortality and need for care during these 1,461 days were tracked. Cox proportional hazard models were used to calculate the hazard ratio (HR) and 95% confidence intervals (CIs) for mortality and loss of healthy life by income level. All analyses were stratified by gender. In addition, an analysis including only subjects who responded to questions about income on the self-administered survey was conducted, and results were compared.

## 4. Results

*4.1. Aggregate Totals, Number of Outcome Events, and Rates of Mortality and Certification of Long-Term Care Need during the Follow-Up Period.* There were 1,328 deaths among men and 944 deaths among women in over 38,442 person-years of observation in men and 48,120 person-years in women. Loss of healthy life was observed in 2,157 men and 2,636 women in over 36,565 person-years of observation in men and 44,483 person-years in women. Followup was not possible for 113 men and 162 women either because they moved out of the area or for other reasons.

*4.2. Main Results.* Table 4 shows the age-adjusted hazard ratios for community-dwelling independent elderly. In men, using death as the endpoint and income level 5 as the reference, hazard ratios reached statistical significance from level 3 (HR 1.55, 95% CI 1.31–1.84) to level 1 (HR 3.50, 95% CI 1.91–6.42). When loss of healthy life was the endpoint, hazard ratios were statistically significant for all income levels compared to income level 5; from level 4 (HR 1.23, 95% CI 1.07–1.41) to level 1 (HR 3.71, 95% CI 2.24–6.13). Among women, when mortality was the endpoint, hazard ratios were statistically significant for level 1 compared to level 5 (HR 2.48, 95% CI 1.09–5.67). When loss of healthy life was the endpoint, hazard ratios were statistically significant for level 2 (HR 1.41, 95% CI 1.10–1.81) and level 1 (HR 2.27, 95% CI 1.43–3.63) compared to level 5.

In contrast, when only those who responded to questions about income on the mail survey were included in the analysis, among men, the hazard ratio, comparing the lowest to the highest income level, was smaller than with the full sample, and, among women, the relationship between income and health was no longer significant.

## 5. Discussion

*5.1. Key Results.* Our study analyzed government health data of independent elderly, and we found that people with lower incomes were more likely than people with higher incomes to lose their health when using both mortality and loss of healthy life as endpoints. The hazard ratio comparing the lowest income level to the highest income level was 3.50 for men and 2.48 for women when using mortality as an endpoint and 3.71 for men and 2.27 for women when using loss of healthy life as an endpoint. When only those who responded to questions about income on the mail survey were included in the analysis, the relationship became weaker.

*5.2. Limitations.* This study has the following limitations. The government data only included information on the taxable income of the individual. Thus, the income of other household members remained unclear. Further, the study only considered income, and accumulated wealth or assets were not included in the analysis. Therefore, in some cases,

TABLE 2: Baseline distribution of data on age and income level.

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | NO. | % | Cumulative % | NO. | % | Cumulative % |
| Total | 10290 | 100.0 | | 12539 | 100.0 | |
| Age | | | | | | |
| 65–69 | 3716 | 36.1 | 36.1 | 3908 | 31.2 | 31.2 |
| 70–74 | 3184 | 30.9 | 67.1 | 3452 | 27.5 | 58.7 |
| 75–79 | 2060 | 20.0 | 87.1 | 2709 | 21.6 | 80.3 |
| 80–84 | 895 | 8.7 | 95.8 | 1490 | 11.9 | 92.2 |
| 85+ | 435 | 4.2 | 100.0 | 980 | 7.8 | 100.0 |
| Income level | | | | | | |
| Level 5 (high) | 2417 | 23.5 | 23.5 | 413 | 3.3 | 3.3 |
| Level 4 | 3113 | 30.3 | 53.7 | 480 | 3.8 | 7.1 |
| Level 3 | 2568 | 25.0 | 78.7 | 7900 | 63.0 | 70.1 |
| Level 2 | 2150 | 20.9 | 99.6 | 3691 | 29.4 | 99.6 |
| Level 1 (low) | 42 | 0.4 | 100.0 | 55 | 0.4 | 100.0 |

TABLE 3: Respondents rate for mail survey and item about income.

| | | Whole sample (A) | Number of respondents for mail survey (B) | Respondents rate (B/A,%) | Number of respondents for item about income (C) | Respondents rate for item about income (C/A, %) |
|---|---|---|---|---|---|---|
| | Total | 10290 | 5513 | 53.6 | 4824 | 46.9 |
| | Age | | | | | |
| | 65–69 | 3716 | 2016 | 54.3 | 1854 | 49.9 |
| | 70–74 | 3184 | 1666 | 52.3 | 1469 | 46.1 |
| | 75–79 | 2060 | 1112 | 54.0 | 939 | 45.6 |
| | 80–84 | 895 | 498 | 55.6 | 389 | 43.5 |
| Men | 85+ | 435 | 221 | 50.8 | 173 | 39.8 |
| | Income level | | | | | |
| | Level 5 (high) | 2417 | 1434 | 59.3 | 1332 | 55.1 |
| | Level 4 | 3113 | 1920 | 61.7 | 1744 | 56.0 |
| | Level 3 | 2568 | 1146 | 44.6 | 890 | 34.7 |
| | Level 2 | 2150 | 1007 | 46.8 | 854 | 39.7 |
| | Level 1 (low) | 42 | 6 | 14.3 | 4 | 9.5 |
| | Total | 12539 | 6375 | 50.8 | 4467 | 35.6 |
| | Age | | | | | |
| | 65–69 | 3908 | 2012 | 51.5 | 1599 | 40.9 |
| | 70–74 | 3452 | 1767 | 51.2 | 1286 | 37.3 |
| | 75–79 | 2709 | 1446 | 53.4 | 934 | 34.5 |
| | 80–84 | 1490 | 754 | 50.6 | 417 | 28.0 |
| Women | 85+ | 980 | 396 | 40.4 | 231 | 23.6 |
| | Income level | | | | | |
| | Level 5 ( high) | 413 | 223 | 54.0 | 172 | 41.6 |
| | Level 4 | 480 | 266 | 55.4 | 209 | 43.5 |
| | Level 3 | 7900 | 4042 | 51.2 | 2772 | 35.1 |
| | Level 2 | 3691 | 1827 | 49.5 | 1308 | 35.4 |
| | Level 1 (low) | 55 | 17 | 30.9 | 6 | 10.9 |

TABLE 4: Age-adjusted hazard ratio for mortality and loss of healthy life.

| | | | | Mortality | | | | Loss of healthy life | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% confidence interval | | | | 95% confidence interval | | |
| | | n | % | Hazard ratio | Lower | Upper | P | Hazard ratio | Lower | Upper | P |
| | | | | Sample subjects are all community-dwelling independent elderly | | | | | | | |
| Men | Income level | | | | | | | | | | |
| | Level 5 | 2417 | 23.5 | 1.00 | | | | 1.00 | | | |
| | Level 4 | 3113 | 30.3 | 1.17 | 0.99 | 1.40 | 0.073 | 1.23 | 1.07 | 1.41 | 0.004 |
| | Level 3 | 2568 | 25.0 | 1.55 | 1.31 | 1.84 | <0.001 | 1.54 | 1.35 | 1.77 | <0.001 |
| | Level 2 | 2150 | 20.9 | 1.53 | 1.28 | 1.82 | <0.001 | 1.73 | 1.51 | 1.99 | <0.001 |
| | Level 1 | 42 | 0.4 | 3.50 | 1.91 | 6.42 | <0.001 | 3.71 | 2.24 | 6.13 | <0.001 |
| Women | Income level | | | | | | | | | | |
| | Level 5 | 413 | 3.3 | 1.00 | | | | 1.00 | | | |
| | Level 4 | 480 | 3.8 | 1.44 | 0.79 | 2.62 | 0.231 | 1.17 | 0.84 | 1.64 | 0.352 |
| | Level 3 | 7900 | 63.0 | 1.42 | 0.90 | 2.25 | 0.129 | 1.12 | 0.88 | 1.43 | 0.363 |
| | Level 2 | 3691 | 29.4 | 1.54 | 0.97 | 2.45 | 0.069 | 1.41 | 1.10 | 1.81 | 0.007 |
| | Level 1 | 55 | 0.4 | 2.48 | 1.09 | 5.67 | 0.031 | 2.27 | 1.43 | 3.63 | 0.001 |
| | | | | Sample subjects are limited to those who responded about income in the mail survey | | | | | | | |
| Men | Income level | | | | | | | | | | |
| | Level 5 | 1332 | 27.6 | 1.00 | | | | 1.00 | | | |
| | Level 4 | 1744 | 36.2 | 1.03 | 0.81 | 1.32 | 0.790 | 1.12 | 0.92 | 1.37 | 0.242 |
| | Level 3 | 890 | 18.4 | 1.42 | 1.10 | 1.84 | 0.008 | 1.47 | 1.20 | 1.82 | <0.001 |
| | Level 2 | 854 | 17.7 | 1.24 | 0.94 | 1.63 | 0.125 | 1.59 | 1.29 | 1.97 | <0.001 |
| | Level 1 | 4 | 0.1 | — | — | — | — | 2.16 | 0.30 | 15.42 | 0.444 |
| Women | Income level | | | | | | | | | | |
| | Level 5 | 172 | 3.9 | 1.00 | | | | 1.00 | | | |
| | Level 4 | 209 | 4.7 | 1.86 | 0.62 | 5.56 | 0.267 | 1.12 | 0.65 | 1.93 | 0.684 |
| | Level 3 | 2772 | 62.1 | 1.72 | 0.70 | 4.19 | 0.234 | 0.91 | 0.61 | 1.37 | 0.661 |
| | Level 2 | 1308 | 29.3 | 1.50 | 0.60 | 3.72 | 0.385 | 1.17 | 0.78 | 1.77 | 0.453 |
| | Level 1 | 6 | 0.1 | — | — | — | — | 0.45 | 0.06 | 3.31 | 0.430 |

these data may not reflect actual economic affluence. In addition, since data other than income, age, and sex were not obtained, there may have been confounding factors that we were unable to adjust for. Hence, these results do not mean a causal link but an observational relationship including confounders such as education level and behavioural risk factors.

*5.3. Interpretation.* This study provides several findings not reported in previous studies. First, the results of this study verifies, using a large dataset with a high follow-up rate (98.8%), the relationship between low income, mortality, and risk of decreased physical and cognitive functioning in a sample of older adults. It is difficult to ensure a high follow-up rate in cohort studies that use functional decline as the endpoint. For example, Beydoun and Popkin [4] followed a sample of 976 out of the original 1,385 subjects (follow-up rate: 70.5%) for three years, Lynch and colleagues [26] followed a sample of 1,124 out of 1,799 subjects (follow-up rate: 62.4%) for 11 years, and Guralnik and Kaplan [5] followed a sample of 496 out of 2,392 subjects (follow-up rate: 20.7%) for 19 years. Second, by comparing all independent elderly included in the government data to those who responded to questions on income in a mail survey, we demonstrated that measurement of the inequality in health is underestimated because individuals with low SES are less likely respond to self-administered surveys.

The finding that the relationship between SES and health indicators is stronger for men than women has been reported in many studies. There are also reports, such as that of Bassuk and colleagues [27], of a strong association between income and mortality in women. In the present study, significantly larger hazard ratios were obtained for men compared to those for women for both mortality and loss of healthy life. However, there are large differences between men and women in the distribution of income, and so when comparing the size of hazard ratios in men and women, due consideration should be given in the comparison of percentile in the groups from which the reference and HR are obtained. Men in the fifth income level corresponding to high income were the top 23.5 percentiles, while women were the top 3.3 percentiles. Since women are understood to be in a higher level, hazard ratios would tend to be larger in women than in men when obtaining the hazard ratios of the lower levels. However, in fact, the hazard ratios for women are smaller than in men. If the top 20 percentiles are taken as the reference for women the same as in men, hazard ratios may become even smaller. Thus, the relation between income and health is thought to be stronger in men than in women.

Our results demonstrated that men and women with low income levels are less healthy than people with high income levels. We compared our results to those of previous studies conducted in other countries. Since income distributions differed among studies, we took this into consideration when comparing results. In the present study, the percentage of people with the lowest income (level 1) was small. Further, people in income level 1 may be more likely to receive certification of long-term care need compared to people of income level 2 or higher, since people receiving public

assistance do not pay for care services. As a result, we used income level 2 for comparison, which corresponds roughly to the 20th percentile from the bottom in men and the 30th percentile in women.

Looking at mortality in this study, the HR was 1.53 in men of the level 2 group, which corresponded to 78.7–99.6% from the top, compared to the reference category (level 5) which is 0–23.5% from the top. In previous studies listed in Table 5 (see Osler et al. [28] and Manor et al. [29]) the top 25% was used as the reference group, similar to the present study. Osler and colleagues reported a slightly higher HR of 1.92 for a comparison of similar groups. Manor and colleagues reported an HR of 1.61 for the 75–100 percentiles, similar to our level 2 group, which can be com-pared to the HR of 1.53 found in our study. In women, the HR comparing the level 2 group, which corresponded to 70.1–99.6 percentiles, to the reference category, which corresponded to the 3.3 percentile, was 1.54. In a study that looked at women 65 years of age, Bassuk and colleagues [27] reported an HR of 2.13 for the 49–100 percentiles compared to the top 5.9%, similar to the reference group used in the present study. Finally, Martikainen and colleagues [9] reported an HR of 1.47 for 70–80 percentiles compared to the top 10% and an HR of 1.51 for the 80–90 percentiles compared to the top 10%. These findings are similar to those found in the present study, as we found an HR of 1.54 for the level 2 group, which corresponds to the 70.1–99.6 percentiles. We take these similarities between our results and those of previous studies as evidence that, while the inequality in health in Japan is not large compared to other countries, neither is it particularly small.

In the present study, the HR for loss of healthy life among men that compared the 78.7–99.6 percentiles to the top 23.5 percent was 1.73. For women, the HR comparing the bottom 70.1–99.6 percentiles to the top 2.3 percent was 1.41. In contrast, Beydoun and Popkin [4], who looked at declining ADL or IADL, reported an HR of 1.69 when comparing the 70–100 percentiles to the top 20 percent.

When comparing our results for all independent elderly to our results for those who responded to questions about income in the mail survey, we found that the hazard ratios were lower for those that responded to the survey for both mortality and loss of healthy life, and, for women that responded to the survey, hazard ratios did not reach statistical significance. These results provide evidence that, when evaluating the inequality in health, underestimation may occur if subjects are limited to people who respond to income items on self-administered mail surveys, and the real inequality in health may not be detected.

Hirdes and Forbes [2] conducted a study using data from the 1995 National Livelihood Survey in Japan and found a lack of support for the relative income hypothesis, which is consistent with the view expressed by Marmot and Smith [11] and Wilkinson [12]. However, Oshio and Kobayashi [30], using National Livelihood Survey data from 2004, and Ichida and colleagues [19], using data from a 2003 independent survey, found that the relative income hypothesis was supported. These differences may be because Japan has entered a period of breakdown in its traditional social

TABLE 5: Comparison between previous studies (HR for mortality, adjusted for age or demographic variables only).

| | Participants | Source of income data | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|
| | | | Percentile | Hazard ratio | 95% CI | Percentile | Hazard ratio | 95% CI |
| The present study (Japan) | 65+ | Government data | 0–23.5* 78.7–99.6 | 1.00 1.53 | 1.28–1.82 | 0–3.3* 70.1–99.6 | 1.00 1.54 | 0.97–2.45 |
| Osler (Denmark) | 20+ | Government data | 0–25* 75–100 | 1.00 1.92 | 1.69–2.17 | 0–25* 75–100 | 1.00 1.64 | 1.47–1.85 |
| Manor** (Israel) | 45–69 | Government data | 0–25* 75–100 | 1.00 1.61 | 1.45–1.79 | | | |
| Bassuk*** (USA) | 65+ | Interview survey (response rate 82%) | 0–14.7* 74.6–100 | 1.00 1.72 | 1.20–2.48 | 0–5.9* 49.0–100 | 1.00 2.13 | 1.34–3.38 |
| Martikainen (Finland) | 30+ | Government data | 0–10* 80–90 | 1.00 2.02 | 1.96–2.08 | 0–10* 70–80 80–90 | 1.00 1.47 1.51 | 1.42–1.53 1.46–1.57 |

* Reference.
** Men only.
*** Population of Connecticut (relatively similar in reference group percentile).

structure (Kagamimori et al. [17]), and socioeconomic inequality in Japan seems to be associated with more serious health consequences. The present study used 2003 data. The inequality in health in Japan may be growing larger as a result of the recent expansions in the income inequality.

## 6. Conclusion

We revealed that the lower income was a significant negative social determinant of active aging with a hazard ratio of 3.71–2.27 for the lowest income people. This was the first cohort study in Japan to examine the relationship between income, mortality, and declines in physical and cognitive functioning using individual level local government data with a high follow-up rate. In addition, we demonstrated that, due to missing data, the inequality in health may be underestimated when data are gathered using self-administered mail surveys.

It is meaningful that the present results, which avoided underestimation of the inequality in health, provided evidence that the inequality in health among older Japanese is similar to that found in other countries. While there is great variety in the measures taken by governments against the inequality in health, from ignoring the inequality altogether to adopting comprehensive, coordinated policies, in Japan and many other countries, measurement of the inequality in health is inadequate (Whitehead [31], Kondo [32]). Thus, measuring the inequality in health is an important first step in beginning to resolve it. Measuring the inequality in health in future surveys in all parts of the country and clarifying the status of these inequalities in health will provide clues for taking the next step necessary to correct the inequality in health and facilitate active aging.

## Acknowledgments

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*Review Article*

# On the Dynamics of Active Aging

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The conceptual basis of active aging is extended with a dynamic systems model, called Janus. The Janus model accounts for the life-course dynamics of simple and more complex growth and decline functions, on the strength of three principles. The first principle of transition states that the unitary lifespan trajectory of development and aging is the product of two complementary forces, growth and senescence, which are effective from conception until death. The first principle solves the traditional problem of the age at which development ends and the process of aging starts. The second and third principles of peak capacity and peak time refer, respectively, to the impact of growth rate (peak capacity) and rate of senescence (peak time) on the life-course of dynamic systems. The validity of the Janus model is demonstrated by simulating the empirical lifespan trajectories of functional capacity, intelligence, and mortality. The Janus model contributes to the concept of active aging by underlining the dynamic limits of human nature, by stimulating effective policies for promoting active aging in the first half of life, and by emphasizing the growth potential of older people in the second half.

## 1. Introduction

The roots of gerontology as a science lie in European scientific developments of the 19th century. The European "Zeitgeist" fostered a strong conviction that the scientific method could be applied to all phenomena and that rational and logical explanations of their causes could be ascertained. Science and its methodology became the doorway to knowledge. In 1835, the Flemish scientist Adolphe Quetelet published the first research report on human development and aging, titled "*A Treatise on Man and the Development of his Faculties*" [1]. The data he reported covered such topics as birth rate, mortality trends by age, stature, weight, and strength, as well as the development of "moral and intellectual qualities of man." The first sentence of the report reflects his scientific orientation: "Man is born, grows up, and dies, according to certain laws which have never been properly investigated, either as a whole or in the mode of their mutual reactions" (page 1). Next, Quetelet describes an extensive research program for the study of the human life course:

"... they (i.e., *Quetelet's colleagues*) have neglected to put forward (...) the study of his physical *development* (bodily growth), and they have neglected to mark by numbers how individual man increases with respect to weight and height—how, in short, his forces are developed, the sensibility of his organs, and his other physical (*and mental*) faculties. They have not determined the age at which his faculties reach their *maximum* or highest energy, nor the time when they commence to *decline*." (page 1) (italics added JS)

Currently, Quetelet's conception of the life-course is known as a sequential two-phase model of growth and decline, with emphasis on the "developmental" aspects of individual life [2].

One decade before Quetelet, the English actuary Benjamin Gompertz [3] had emphasized the "aging" aspects in a paper "*On the Nature of the Function Expressive of the Law of Human Mortality*." He made the observation based on death and population records for people in England, Sweden, and France that there is an exponential rise in death rates between ages 20 and 60, that is, the so-called law of mortality. Partly

due to the work of Makeham [4], the age range was extended from 10 to 80 years [5].

In the 20th century, Gompertz' name was commonly attached to the full mortality curve for population data, from birth to death. It is important to note that this curve refers not only to the 20–60 or 10–80 age range, but also to the first age period of decreasing mortality from 0 to 10 or 20 years. In other words, the Gompertz curve is characterized by two sequential phases of decreasing and increasing mortality, commonly interpreted as development and aging (senescing), with the minimum varying from 10 to 20 or even 30 years. As such, the Gompertz curve might be conceived as the inverse of Quetelet's growth and decline curve. Both curves confirm the traditional view that the human life course consists of two sequential processes of change, development and aging, with the maximum (Quetelet) or minimum (Gompertz) at maturity or adulthood. This view raises the long-standing, but increasingly relevant question of how development and aging are related [6].

## 2. The Study of the Aged, Age, and Aging

As Gompertz, Quetelet, and many others after them have argued convincingly, aging does not start at 65, and development does not stop at 10 or 20. Nevertheless, both developmental science and gerontology have acted for a long time "as if" they did. Around the turn of the 19th century, one seems to have adapted the concepts of development and aging from areas of disciplines that were not oriented to explaining change. The earlies, biology, psychology, and sociology were based on static properties. This focus gave little encouragement to the study of the dynamics of development and aging. With regard to the field of gerontology, three foci can be distinguished: the aged, age, and aging.

First, *the study of the aged*—whether the young-old or the old-old—focuses on the characteristics of problematic and nonproblematic elderly while following a thematic approach. Even a cursory glance at the literature shows that there are at least thirty different themes, varying from sensation and perception, attachment and bonding, sexual behavior and personality to depression and dementia, competence and wisdom, age, and the search for meaning [7]. Thematic studies with regard to special services for the elderly (e.g., nursing homes and old people's homes) are not taken into account, but even without these studies the field of gerontology does not provide a coherent sight. Careful descriptions of aged persons are useful as a basis for meeting the needs of the elderly but do not of themselves provide insight into the origins of their needs. For lack of theory, the field has heavily borrowed from older, and certainly more respectable "islands of knowledge" in medicine and psychology. As such, the study of the aged bears a resemblance to the much older field of child medicine and child psychology, which study the first stages of the human life span.

Second, the content of *the study of age* has been largely derived from cross-sectional research, describing and comparing persons of different ages measured at the same time. This approach results in cross-sectional age differences, which are often erroneously interpreted as age changes, aging, or changes in health and behavior over time. It is a persistent fallacy to suggest that some decline on the basis of cross-sectional data is caused by age or the aging process. Although age is a convenient broad index, it is a dummy variable in the sense that it does not stand for a single process but for many processes that may operate independently. The observed decline on the basis of cross-sectional age differences might have been caused by other conditions besides changes with age, like the lower education of the older age group as compared with the higher education of the younger group.

Third, *the study of aging* is concerned with patterns and processes of change in individuals as they develop and grow old. Findings suggest that there is a wide range of individual differences in the rate and manner of aging at all levels of analysis, biological, psychological, and social (cf. *The handbooks of aging* [8], consisting of three volumes, seven editions, 1977–2011). The chronic lack of theory makes it difficult to integrate the different findings. As the classic dictum says "The study of aging is data rich and theory poor, a vast collection of unintegrated pieces of information." No wonder that so many concepts of aging have been developed, each with a different name and connotation. Negative concepts vary from problematic and abnormal aging to pathological aging, neutral concepts include primary, nonproblematic and normal aging, while positive aging or "aging well" might be referred to as healthy, succesful, optimal or productive aging. All these terms are considered as multidisciplinary, multidimensional, and multilevel concepts.

In 2002 the WHO has added the new term of *active aging* to the list of positive concepts [9]. Fernandez-Ballesteros [10] summarizes the three most important bases of active aging: (1) compression of morbidity and mortality, (2) the diversity of the ways of aging, and (3) the plasticity of human nature. In this article the basis of active aging will be extended with (4) life-course dynamics [11].

## 3. Human Ontogenesis

Birren and Cunningham [12] present a minimal definition of aging as "some typicalness of change over time in mature organisms." Minimal though it is, the definition nevertheless raises two questions: (a) to what extent are processes of development and aging different from each other, as both processes alike refer to age-related changes, and (b) how is the transition from developmental processes into aging processes to be explained, as aging starts at maturity. The answer to these questions has been given from different theoretical perspectives.

In 1960, Birren presented a general theory of aging as a *counterpart* of development [13]. The use of the metaphor "counterpart" is meant to express the idea that there are latent structures of behavior (emotions, cognitions, and motivations) carried forward from earlier experience that interact with present situations. Aging is viewed as a transformation of the biological and behavioral development of the organism expressed in a "counterpart manner" in variable ecological contexts.
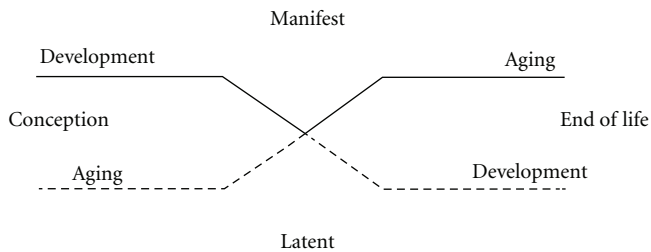
FIGURE 1: "Butterfly" diagram illustrating the relationship of the processes of development and aging over the course of life [16].
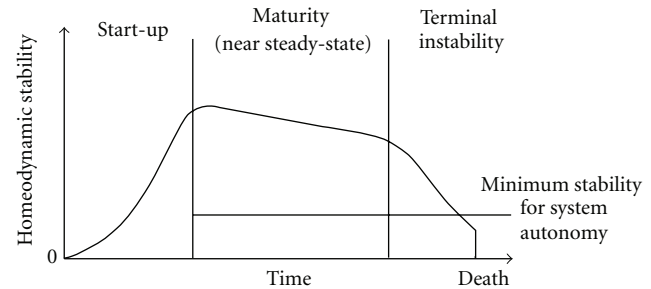


FIGURE 2: Homeodynamic stability as a function of time in a self-organizing system [19].



FIGURE 3: Energetics of a self-organizing system during growth and maturity [22].

Counterpart theory explains the diachronic relationship between development and aging but does not address the issue of their synchronic relations. To solve this issue Schroots and Birren [14, 15] developed a simple diagram of human ontogenesis, in which development and aging are conceptualized *metaphorically* as two parallel but related processes of change, or as the two sides of a unitary life trajectory (Figure 1). At the start of ontogenesis (conception), the developmental process is the most visible or manifest, while the signs of aging are at the time still obscure or latent, and vice versa at the end of life. It should be noted that across the lifespan, the transition point varies from function to function, from system to system, and from individual to individual. The "butterfly" diagram illustrates clearly the modern conception of development and aging as two simultaneous processes of change, from conception to death, which manifest themselves successively in the form of a unitary life trajectory (solid line). As such, the butterfly diagram functions as a metaphor for a dynamic life-course model, in which aging is the diachronic and synchronic counterpart of development both before and after the transition point [16].

In 1987, Baltes [17] addressed a similar question with regard to the relationship between development and aging, when he introduced the so-called *gain/loss* view of development:

"According to this view, development at all points of the life course is a joint expression of features of growth (gain) and decline (loss). It is assumed that any developmental progression displays at the same time new adaptive capacity as well as the loss of previously existing capacity. No developmental change during the life course is pure gain" (page 616).

In other words, there is no free lunch in life. By way of illustration, Baltes developed a possible life-span scenario of the dynamics of gains and losses, in which the sum total of possible gains and losses in adaptive capacity shifts proportionally with increasing age [17].

Starting from a living systems perspective, Yates [18] developed a prototheory of the *dynamics* of aging. Briefly summarized, Yates hypothesizes that there is some quality informally called vitality or health that expresses the overall dynamic stability of a living system. That stability is homeodynamic, that is, the mean levels of most of the state variables are closely determined, but the variances around them can be very large. Also, the stability of living organisms is not so strict, that they cannot grow and adapt within their lifetimes.
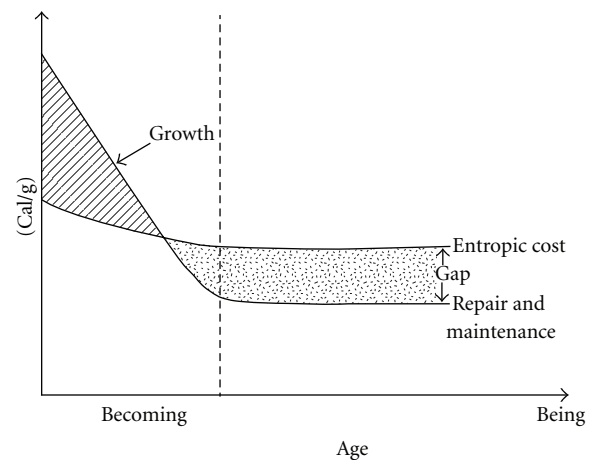
The diagram in Figure 2 shows the degree of homeodynamic stability as a function of time in a self-organizing system [19].

A newborn organism is less stable than it will be at maturity. For the human being, the left vertical line, marking the achievement of maturity and maximal stability, occurs at age approximately 30 years, at which time, the capacity of many physiological processes is at its peak. After age 30, there is a linear decline and loss of "reserve," even when the data are corrected to eliminate disease [20]. Death from "old age" occurs when the physiological losses beginning at maturity have progressed to the point that the stability crosses the minimum required for system autonomy. Translated in dynamic terms, the life trajectory of the self-organizing system begins with growth, development, and differentiation, all of which are negentropic processes that initially mask the ongoing process of senescence. After maturity is reached, the entropic processes become dominant or manifest, leading to a destruction of order in the organism [21, 22].

In Figure 3, the ordinate shows the energetics (metabolism) of the self-organizing system during growth and maturity. Negentropic (anabolic) processes exceed the entropic (katabolic) costs of repair and maintenance during the stage of growth. After maturity is reached, no net further gain in differentiation occurs and the metabolic process becomes entropic in the net. Figure 3 shows clearly that the
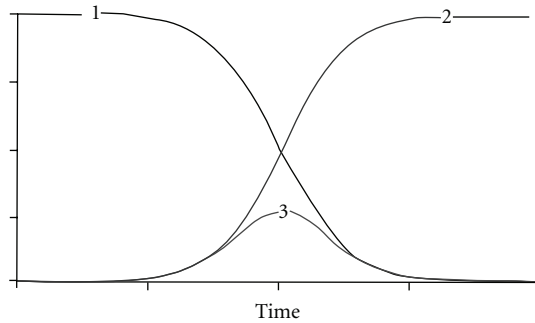
FIGURE 4: Theoretical model of the "butterfly" diagram: (1) negative growth curve, (2) positive growth curve, and (3) bell-shaped curve [11].



FIGURE 5: Life trajectory simulation of the functional capacity in human beings [11, 25].

process of senescing runs concurrent with growth, development and differentiation in a self-organizing system; but until the growing phase is completed, senescing is masked and not easily detected. In that sense, Yates' homeodynamic perspective on senescing shows some similarity with counterpart theory and gain/loss conceptions of aging, but how the transition occurs from development into aging is not explained.

## 4. Computer Simulation of Development and Aging

Recently, theoretical progress has been made thanks to the introduction of computer modeling and simulation techniques. The first step in computer simulation relates to the construction of a theoretical model (Figure 4) on the basis of metaphors for development and aging, that is, the "butterfly" diagram (Figure 1).

The model in Figure 4 shows three curves: Curves 1 and 2 represent the mathematical equivalent of development (negative growth) and aging (positive growth), respectively, as shown in the "butterfly" diagram of Figure 1; the bell-shaped curve 3 is the mathematical product of development and aging (solid line in Figure 1) and represents the unitary life trajectory of a virtual system with the apex (peak) at the *transition* point of development and aging. The three curves have been made symmetrical to illustrate the similarity to Figure 1. However, the peak of the life trajectory (curve 3) might move up or down (*peak capacity*), and to the left or right (*peak time*), depending on the growth parameters of curves 1 and 2, respectively (e.g., the asymmetrical graph in Figure 5).

It should be noted, firstly, that the representation of development as negative growth seems paradoxical, but is in fact logical, viewed from the central idea that the growth rate is highest at birth (or conception) and steadily declines thereafter [23, 24]. Following the same line of reasoning, aging is conceived, conversely, as the process with the lowest growth rate at birth and the highest rate at the end of life. The second note is that the mathematical equivalents (differential equations) of the three simulated curves are at the basis of a dynamic life-course model, which is called *Janus* after the
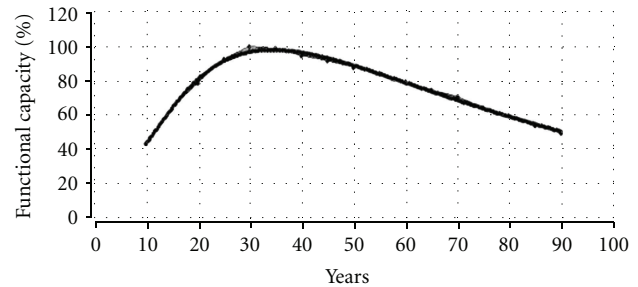
Roman god with two faces—one face looking into the future and one into the past [11]. The Janus model has simple and more complex versions (see Appendix). Both versions will be used for the next step.

The second step relates to the simulation of empirical data. By way of illustration, we will simulate the life trajectories of (a) general physiological performance, (b) fluid and crystallized intelligence, and (c) U.S. mortality in the years 1910 and 1970.

*(a) General Physiological Performance.* Starting from various datasets, Kemper and Binkhorst [25] plotted the idealized life trajectory of the functional capacity in human beings. We have simulated this trajectory with the simple version of the Janus model, and the resulting graph (bold line) in Figure 5 seems to fit almost perfectly the empirical data set of functional capacity over a period of 10 to 90 years, with a peak performance of 100% at ca. 30 years and 80% performance at the age of 60.

It should be noted that the combined forces of life, that is, growth and senescence—not shown in Figure 5, but similar to the forces of negative growth (curve 1) and positive growth (curve 2) in Figure 4—influence the life trajectory of development and aging in such a way that the peak (apex) of functional capacity is reached at about 30 years, after which the vitality or functional capacity declines gradually, varying between 0.5 and 1.0% per year depending on the individual and the organ system, but in this case declining with ca. 0.7% per year [20].

The implications of the simple Janus model for the physiological performance of people in general can be demonstrated by means of two well-known sayings *Soon ripe, soon rotten*, and *Live fast, die young*. Peak capacity, for example, relates to the phenomenon that rapid growth in the phase of development leads to rapid decline (Soon ripe, soon rotten), with the result that the functional capacity of the individual reaches its critical capacity for survival at a younger age than would have been the case with slow growth (on the condition that the rate of senescence is constant). Peak time, on the other hand, is related to rate of senescence: higher rates of senescence (at a constant growth rate) mean that the individual reaches his or her peak and critical threshold at an increasingly early age (Live fast, die young).
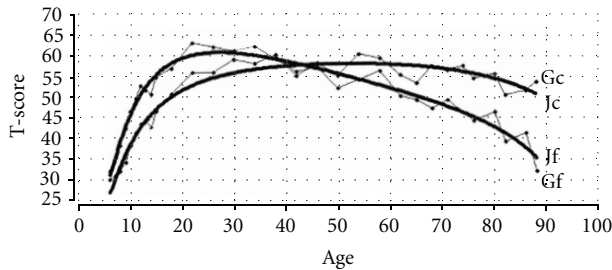
FIGURE 6: Life trajectory simulation of fluid (Gf) and crystallized (Gc) intelligence (dotted) with the Janus model (bold): Jf = fluid; Jc = crystallized [11, 28].



FIGURE 7: Simulation of U.S. mortality in the years 1910 and 1970 (dotted: $M_{10}, M_{70}$) with the Janus model (bold: $J_{10}, J_{70}$) [11, 30].

*(b) Fluid and Crystallized Intelligence.* Simple life-trajectories show two phases: development and aging, and one transition. Development is often compared with incremental processes of change and aging with decremental processes. The classic metaphor for biological processes of change is that of the *hill* with the top at about 30 years for general physiological performance [16]. For a few decades, however, the notion has been growing that psychological processes of change do not necessarily parallel biological changes along the lifespan. The psychological attribute of wisdom, for instance, represents a progressive aspect of change in middle and late adulthood and challenges the traditional decline view of aging [26]. The question now arises whether there is a fit between the Janus model and, for instance, general intelligence or mental abilities.

Traditionally, general intelligence is divided into two types of mental abilities: "fluid" or spatial-analytical abilities (abstract reasoning), which refer to basic processes of speed of information processing, and "crystallized" abilities, which refer to the storage of information (e.g., cultural knowledge and experience). The lifespan patterns of both abilities show a rapid rise until early adulthood, followed by a period of relative stability in respect of the crystallized abilities until the age of about 60–70 years, but a distinct decline in the fluid abilities after early adulthood [27]. As such, the lifespan curve of fluid abilities bears a strong resemblance to the general physiological performance curve (two phases, one transition), while the crystallized abilities curve includes an extra relative stability phase between early adulthood and the later years, that is, three phases and two transitions. In order to simulate these divergent lifespan patterns, a more complex, but essentially similar version of the Janus model has been used. In Figure 6, the lifespan curves of fluid (Gf) and crystallized (Gc) intelligence are presented (dotted lines, copied from Li et al. [28]), as well as the simulated fluid (Jf) and crystallized (Jc) Janus curves (bold lines), from Schroots [11].

Figure 6 shows a satisfactory fit between the simulated Janus curves and the empirical fluid and crystallized intelligence graphs. As expected, fluid intelligence follows the traditional pattern of development (6–27 yrs) and aging (27–88 yrs) with the peak at about 27 years. Birren and Fisher [29] explain this pattern by noting that fluid abilities are primarily based on the neurobiological property of
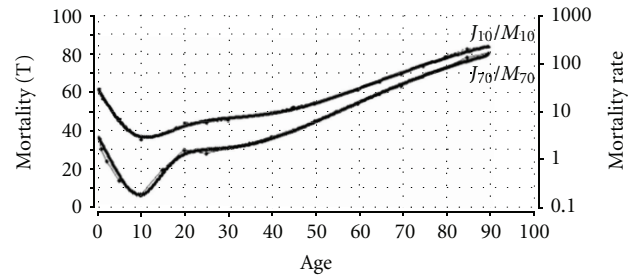
*information processing speed.* As such, the dynamics of fluid intelligence generally corresponds to the life trajectories of many other biological systems that reach their peak performance in early adulthood and decline afterwards [20] (see Figure 5). The neurobiological roots of fluid intelligence imply that the individual's fluid capacity is as little modifiable as his or her functional capacity.

In contrast to fluid intelligence, crystallized intelligence continues to develop, though more slowly, from age 27 to the peak age of about 50 years then stabilizes more or less at peak level until the 60–70 age period, thereafter, finally declining more rapidly until the end of life. If fluid intelligence relates to speed of information processing, then crystallized intelligence relates to *storage of information* (memory, knowledge, experience), which is less susceptible to neurobiological decline. Information processing precedes storage of information, which makes it likely that crystallized intelligence is composed of both information processing and storage of information. From a dynamic systems perspective, crystallized intelligence, therefore, rides piggyback on fluid intelligence, which explains crystallized abilities' period of relative stability after early adulthood until their distinct decline at an advanced age. The partly neurobiological, partly cognitive, and cultural roots of crystallized potential imply that specific mental change processes, like life-long accumulation of knowledge, wisdom, and experience, are a reality until late in life.

*(c) Mortality.* The third empirical dataset relates to mortality and is borrowed from Fries and Crapo [30], who presented a graph of vital statistics from the United States for 1910 and 1970. For scale-technical reasons, the semilogarithmic mortality data were transformed linearly before the copied graph data were imported into the simulation program. Figure 7 presents the empirical mortality data for the United States in the years 1910 ($M_{10}$) and 1970 ($M_{70}$), as well as the simulated Janus curves $J_{10}$ and $J_{70}$ [11]. Note that the transformed (T) linear scale of the left $y$-axis (0–100) is labeled "Mortality (T)" and that the original, logarithmic scale of the right $y$-axis (0.1–1000) is labeled "Mortality Rate."

Figure 7 shows an almost complete overlap between the Janus curves (bold) and the mortality data (dotted). As such, the fit between the Janus curves ($J_{10}, J_{70}$) and data plots ($M_{10}, M_{70}$) is more than satisfactory. Both Janus curves can be characterized in terms of development (decreasing
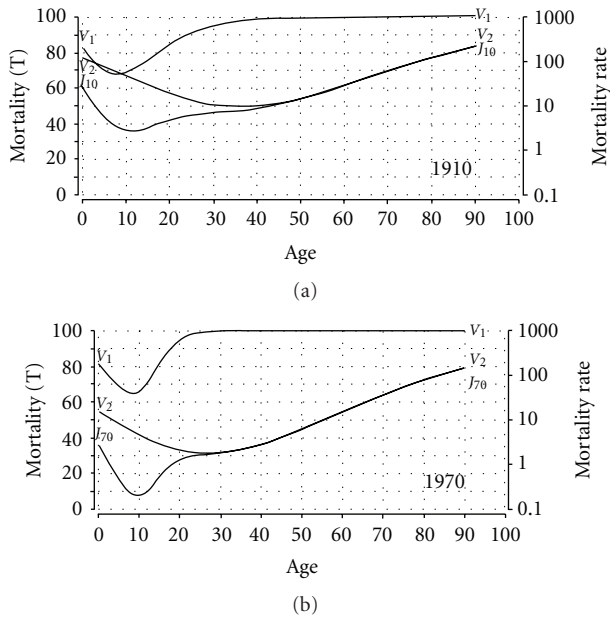
(a)



(b)

FIGURE 8: (a): Janus curve ($J_{10}$), $V_1$ and $V_2$ curves of U.S. 1910 mortality. Bottom panel: Janus curve ($J_{70}$), $V_1$ and $V_2$ curves of U.S. 1970 mortality.

mortality) and aging (increasing mortality), with the lowest probability of death (minimum) at the age of about 10. However, there are also differences between the $J_{10}$ and $J_{70}$ curves. First, the minimum mortality was much higher in 1910 than in 1970. This huge drop in mortality is generally attributed to the improvement in the overall health of western populations. Second, the Janus curves, particularly the $J_{70}$ curve, are not smooth over the ages 10–30 ($J_{70}$) and 10–45 ($J_{10}$); this irregularity or "bump" in the mortality curve represents traumatic deaths (accidents), which peak during these ages.

In this context, Fries and Crapo [30] maintained that since 1910 "the relative importance of trauma has increased greatly; such deaths made up nearly 75% of all deaths between ages 15 and 25" (page 28). After the "bump" period, the mortality rate of both curves displays an upward slope until the age of ca. 90.

From an analytical perspective, the Janus curves can be resolved into system curves $V_1$ and $V_2$. In Figure 8, the Janus curves, as well as the $V_1$ and $V_2$ curves are presented for the years 1910 (top panel) and 1970 (bottom panel). The data plots have been omitted from the figure for convenience and visibility. Note that, due to the limited graphical resolution, the exact bifurcation points of the Janus and system curves only become visible after enlargement of the figure.

Figure 8 indicates that the minimum mortality of both the Janus curves practically coincides with the transition (minimum) of the $V_1$ curves at the age of ca. 10. After visual inspection of the $V_2$ curves in the enlarged figure, it was determined that the $V_2$ minimum for 1970 (bottom panel) coincides with the Janus curve at the end of the "bump" period (ca. 27–30 years), and that the $V_2$ minimum for 1910

(top panel) is reached at the age of ca. 37. The latter is well before the end of the "bump" period (ca. 45–50 years). The question arises how the first ($V_1$) and second ($V_2$) systems in the Janus model framework should be interpreted.

With regard to the first system, the interpretation should not be too difficult, that is, the $V_1$ curve reflects the impact of environmental and pathological conditions, as well as of accidents on individual lives. The reasoning is as follows. Given negative prenatal, perinatal, and postnatal conditions (e.g., congenital defects, infectious diseases), infant mortality will be high and, consequently, the impact of accidents in adolescence and young adulthood will be relatively low, as shown for the year 1910 in which the "bump" is hardly visible. However, if the overall health conditions are improved, as in 1970 western society with its public services (e.g., potable drinking water, community health programs, sewers, etc.), infant and childhood mortality will be low. Consequently, the "bump" mortality of adolescence and young adulthood emerges relatively distinct from what is presumably the natural, intrinsic mortality of human beings as reflected by the $V_2$ curve (see bottom panel of Figure 8). In other words, the first system of *extrinsic* mortality dominates the second system of *intrinsic* mortality, but in combination they produce the full Gompertz curve as simulated by the more complex version of the Janus model.

On the whole, the $V_1$ curve primarily reflects the shift in the mortality dynamics of an increasingly healthy (or unhealthy) population [31]. The $V_2$ curve, on the other hand, expresses the basic mortality dynamics in the form of an inverse growth and decline function that is intrinsic to the human organism, and relatively independent of the environment.

## 5. The Janus Model of Life-Course Dynamics

Generally, the Janus model offers a quite satisfactory account of the life-course dynamics of simple and more complex growth and decline functions. The simple version of the Janus model (two phases, one transition) is based on the simultaneous and complementary action of two coupled forces, growth and senescence, which determine the dynamics of living systems, or—to put it differently—define the one-peak life trajectories of dynamic systems. The extended version of the Janus model covers the more complex, two-peak trajectories (three phases, two transitions). Note that the forces (processes) of growth and senescence should be conceived as postulates of the same order as the physical force of gravity, which does not as yet have a clear explanation.

The term "living system" is extracted from Miller's systems theory [32], which states that humans are primarily regarded as living systems, hierarchically organized from many subsystems such as cells, cell tissues, organs, among others, according to their complexity levels. As a system, humans can be conceived as part of an even more complex, larger system, for example, the social and physical environment. From the latter point of view, it depends on the system level whether the term "living system" or "dynamic system" is used. Whatever term is selected, the Janus model is primarily a mathematical, "empty" model that fits the

growth and decline curves of widely divergent systems from biological and psychological systems to social and demographic systems. However, once interpretation and context are added, the mathematical model loses its separate identity, and the scientist finds him or herself in the process of theory development.

The construction of the Janus model revealed three principles. The first principle of *transition* solved the traditional problem of the age at which development ends and the process of aging starts. This principle states that the apparent unitary lifespan trajectory of development and aging is in fact the product of two complementary forces, growth and senescence, which are effective from conception until death. The second and third principles of *peak capacity* and *peak time* refer, respectively, to the impact of growth rate (peak capacity) and rate of senescence (peak time) on the lifecourse of dynamic systems and of human beings in particular. Different growth rates with a constant rate of senescence have implications for the peak capacity and the residual lifespan after the transition point. Rapid growth, for example, leads to a higher peak at a certain age, and also to rapid decline and a shorter residual lifespan than slow growth, which results in a lower peak, slower decline, and a longer residual life trajectory after the point of transition. On the other hand, different rates of senescence with a constant growth rate mainly have implications for peak time (age), peak capacity, and the total lifespan. Rapid senescence, for example, results in a higher peak at a younger age, and also in a shorter lifespan than slow senescence with a lower peak at an older age and a longer total lifespan.

Generally, growth rate refers to the system's maximum capacity (2nd principle) and the rate of senescence refers to the age at which the system reaches its maximum capacity (3rd principle). Note, however, that the forces of growth and senescence are confounded, unless one of the two forces is kept constant, for example, in a quasi-experimental design.

## 6. Active Aging from a Dynamic Perspective

The question arises what the Janus model might contribute to the life-course dynamics of active aging. Starting from Fernandez-Ballesteros' summary [10] of the three bases of active aging, the first base with respect to the *compression of morbidity and mortality* will be illustrated with the simulation of U.S. mortality for 1910 and 1970 (see Figure 8). It was found that the Janus model for two coupled systems could resolve overall mortality in two components, tentatively labeled as intrinsic and extrinsic mortality. The first component of extrinsic mortality (1st system) reflects the fatal impact of environmental and pathological conditions, as well as accidents on individual lives. The extrinsic mortality curve indicates a minimum in respect of the age of ca. 10 and extends from birth to about the age of 50 in 1910 and to about age 30 with regard to the 1970 data. According to the third principle of peak time, this means that the rate of senescence in the first system is constant for both 1910 and 1970. The second principle of peak capacity (growth rate) thus explains the differences between the first system's 1910 and 1970 curves with regard to the minimum and

residual trajectories. In other words, the rapid decrease of negative conditions in 1970 leads to a lower minimum mortality and shorter residual trajectory (ca. 10–30 yrs) than the slow decrease of 1910 with its higher minimum mortality and longer residual trajectory (ca. 10–50 yrs). From this perspective, the 1910 and 1970 extrinsic mortality curves serve as example of a quasi-experimental, demographic design with a variable peak capacity and constant peak time.

The second component of intrinsic mortality reflects the human organism's inherent, natural capacity to adapt to life. The intrinsic mortality curve (2nd system) extends over the full lifespan (0–90 yrs) for both 1910 and 1970 with minimum mortality from about age 37 in 1910 to age 27 in 1970. Note that the age shift of minimum intrinsic mortality from 37 to 27 years is coupled with an improvement in living conditions and lower extrinsic mortality. Note, moreover, that the minimum intrinsic mortality in 1970 (ca. 27 yrs) corresponds to the peak of general physiological performance at about the age of 30 [25]. It is, therefore, not unreasonable to assume that intrinsic mortality's inverse growth and decline curve reflect some basic survival mechanism, also called adaptability or functional fitness, which reaches its maximum strength at the age of ca. 30.

Generally, the compression of morbidity and mortality is reflected in the shift over time and/or level of extrinsic and intrinsic mortality. The environment's impact on mortality (*nurture*) dominates in the first 30 to 50 years of life and from then onwards our mortal *nature* becomes manifest. It would be interesting to learn whether the Janus model of two coupled systems could clarify other nature-nurture problems as well.

The second base of active aging refers to the *diversity of the ways of aging*. Varied life trajectories reflect among other things the impact of general aging processes on the course of life. The diverse trajectories have been demonstrated by means of the Janus model at the psychological (intelligence) and demographic (mortality) levels of dynamic systems (Figures 6, 7 and 8), but not at the biological (health) level. Starting from the Gothenburg longitudinal dataset, Svanborg [33] illustrated the dynamics of aging at the functional performance level in the form of a diagram showing four phases (Figure 9):

" … the first illustrating *growing and maturation*, the second a commonly occurring more or less *stationary phase*, a third with a decline in *functional performance*, usually about 1% per year, and finally a *terminal phase* with an accelerated rate of aging (…). It might be reasonable to predict that during this terminal phase with a rapid decline in functional performance the reserve capacity of different organs and organ functions should be very low, and that possibilities for stimulation of, for example, muscle function during that period might be very limited or nonexistent." (page 137).

The diagram in Figure 9 represents the idealized composite of three datasets, which illustrate both the simple (1-peak) and complex (2-peak) Janus model of life-course dynamics. The first (I) phase of growing and maturation, followed by the first dotted trajectory of decline, corresponds with the simple Janus model of development and aging (cf. Figure 5). The complex, 2-peak Janus model might cover
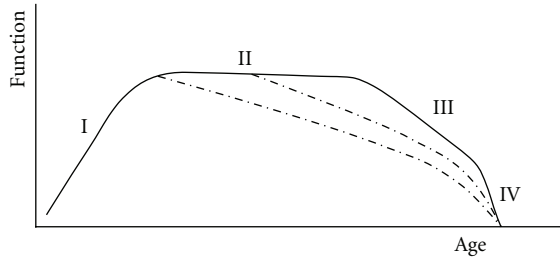
FIGURE 9: Idealized life trajectories of functional performance. Some functions (- - - -) decline earlier than others [33].
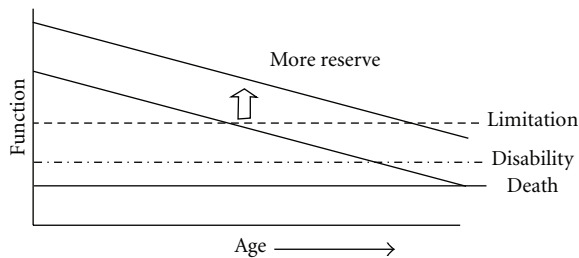


FIGURE 10: Hypothesized relationship between physiologic aging, functional health and chronological age [34].

the first (I), second (II), and third (III) phases of the total life trajectory, that is, development (growth)—stationary phase—aging (decline), and could also be fitted to the last three phases (II, III, IV), depending on the model parameters (cf. Figure 6). Note that the diagram in Figure 9 shows only a few of all possible aging trajectories. It would be interesting, therefore, to find some order in the confusing diversity of aging processes.

Figure 10 shows a diagram of the hypothesized relationship between physiologic aging, functional health and chronological age, as presented by Kritchevsky [34]. The diagram illustrates how the three Janus principles of transition, peak capacity, and peak time might be applied in disentangling the underlying mechanisms of diverse aging trajectories.

First, note that the developmental trajectories are not shown in the diagram for better understanding of the parallel aging trajectories. Next, it is assumed that the $y$-axis of functional health represents the transition between development and aging. This means—according to the simple 1-peak Janus model—that the peak time of aging trajectories is constant and that their peak capacity varies, depending on the rate of development. Given the higher and lower peak capacity of the two parallel aging trajectories, the diagram shows clearly the late life health effects (limitation, disability, death) of both rate of development and differences in reserve capacity. In case of nonparallel trajectories (not shown), the complex 2-peak Janus model should be applied.

The third base of active aging refers to the *plasticity of human nature*. "Plasticity" is the protean term for saying that human beings can change over the course of life and that specific changes like active aging can be effected by policies and interventions. Obviously, unlimited change is out of the question. A fruitful approach would be, therefore, to

emphasize the dynamic limits of human nature in the first place, rather than its plasticity. For instance, since the beginning of the last century, about 30 years have been added to the average life expectancy, at least in developed countries. Against this rapid increase in length of life, life-course dynamics sets a probabilistic maximum life-span potential of 120 to 130 years with concomitant rectangularization of the survival curve [19, 22]. Given the natural limits, simulation of the mortality curve with the Janus model would predict increasing rectangularization, as a result from increased survival at all ages, but especially at the young and middle ages [11]. Consequently, effective policies for promoting active aging should be considered primarily in the first 30 to 50 years of life rather than in the second half [35].

Vital statistics like mortality and morbidity have a negative connotation, due to the emphasis on the limits of human nature. On second thoughts, a positive approach of active aging would focus on its dynamics and use the term *human potential* within the natural constraints of life. In the *Mature mind*, Cohen [36] presents an overview of what happens to the brain as it ages, and what effects those changes have on our lives: (a) the brain has the capacity to "remodel" itself— certain genes are activated by experience as we age, allowing our personalities to grow and change in surprising ways (b) the brain can "recruit" areas of itself that were formerly underused, thus these strength and agility reserves can compensate the aging effects in other parts of the brain and (c) it is in the latter stages of life, at age 60–80, that the brain's "information processing centre" achieves its greatest density and reach. In other words, Cohen emphasizes the hidden growth potential of individuals in the second half of life.

In 2008, Becker and Schroots [37] published a volume, titled *Releasing the potentials of senior scholars and scientists*, a.o. composed of the following chapters: "The hidden resources and life-course dynamics of academics, particularly the lifespan development of their physical and mental abilities" (Schroots); "The consequences of the pattern of generations in science" (Becker); "The negative effects of mandatory retirement on active aging and the availability of scientific personnel" (Fernandez-Ballesteros et al.); "Senior scholars and scientists' various role models" (Birren et al.). In these chapters, the contours of a new research domain become visible, in which the *growth potential* of older people is explored after the transition point of development and aging [38, 39]. Expectations are that the Janus model of life-course dynamics can play an important role in the further development of the field.

## 7. Summary

In this article, the dynamics of active aging is discussed at different levels of theorizing, varying from the level of history and metaphor to the level of model and theory. Starting from the early history of development (Quetelet) and aging (Gompertz), a brief overview is presented of the study of the aged, age and aging. Integration of the different findings turns out to be difficult, due to a chronic lack of theory.

At the level of metaphor, three conceptions are discussed: counterpart (Birren), butterfly (Schroots and Birren), and

gain/loss (Baltes). The counterpart metaphor explains the diachronic relationship between processes of development and processes of aging, in addition to which the butterfly metaphor assumes a synchronic relationship from conception to death. The gain/loss view of development implies that development at all points of the life course is a joint expression of features of growth (gain) and decline (loss).

From a theoretical perspective, the discussion is focused on the Dynamics of self-organizing systems (Yates and Schroots). Development and aging, defined as primarily negentropic and entropic processes, respectively, are conceptualized as two parallel but related processes of ontogenetic change or as two sides of a unitary life trajectory.

On the basis of the "butterfly" metaphor for development and aging, a dynamic systems model is presented, that is, the Janus model (Schroots), which offers a quite satisfactory account of the life-course dynamics of simple and more complex growth and decline functions. The Janus model is characterized by three principles: transition, peak capacity, and peak time. The first principle of transition solves the traditional problem of the age at which development ends and the process of aging starts. This principle states that the apparent unitary lifespan trajectory of development and aging is the product of two complementary forces, growth, and senescence, which are effective from conception until death. The second and third principles of peak capacity and peak time refer respectively to the impact of growth rate (peak capacity) and rate of senescence (peak time) on the life course of dynamic systems. The validity of the Janus model is demonstrated by simulating the empirical lifespan trajectories of functional capacity, intelligence, and mortality.

In conclusion of the article, the contribution of the Janus model is discussed in respect of the life-course dynamics of active aging. Starting from the three bases of active aging—compression of morbidity and mortality, diversity and plasticity—the Janus model contributes to the concept of active aging by underlining the dynamic limits of human nature, by stimulating effective policies for promoting active aging in the first half of life, and by emphasizing the growth potential of older people in the second half. The Janus model of life-course dynamics can play an important role in establishing the fourth base of active aging.

## Appendix

*Simple Janus Model.* Processes of development and aging are reduced to the more elementary form of one-dimensional growth, which follows an S-shaped power curve in which there is a limit to growth, that is, the logistic or limited growth curve. Mathematically, the logistic curve can be expressed in a differential equation in terms of either negative or positive growth, where the limit $C$ is constant. Development and aging are then reduced to, respectively, negative ($x$) and positive ($y$) growth:

$$\frac{dx}{dt} = -\frac{x\,(C-x)}{C}, \qquad (A.1)$$

$$\frac{dy}{dt} = \frac{y\,(C-y)}{C}. \qquad (A.2)$$

Starting from Herbart's formula [40]: $xy/(x+y)$ or $xy/C$, equations (A.1) and (A.2) can be rewritten in terms of variable $V$ (=living system). Mathematical coupling of the two equations results in differential equation (A.3), which describes the simple life trajectory of a living system:

$$\frac{dV}{dt} = \frac{V(x-y)}{x+y} = \left[\frac{x-y}{C}\right]V, \qquad (A.3)$$

*Complex Janus Model.* Differential equation (A.3) of the simple model can be extended with an extra mathematical term that is equal to the original equation. Mathematical coupling of the two differential equations will then result in differential equation (A.4) of what has been called the more complex *Janus* ($J$) model after the Roman god with two faces—one face looking into the future and one into the past Schroots [11]:

$$\frac{dJ_V}{dt} = \frac{V_1(x-y)}{x+y} + \frac{V_2\,(v-w)}{v+w}. \qquad (A.4)$$

Analogous to Herbart's formula, (A.5) shows in a contracted form the formula of the more complex Janus model ($J_V$) for two living systems ($V_1$, $V_2$):

$$J_V = V_1 + V_2 \qquad (A.5)$$

in which $V_1 = pxqy/(px+qy)$ and $V_2 = rvsw/(rv+sw)$, parameters $p$ and $r$ represent the rate of growth, and parameters $q$ and $s$ the rate of senescence.

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*Review Article*

# Generativity as a Route to Active Ageing

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We elucidate the significance of active ageing from an individual as well as from a societal perspective. Taking an individual perspective, maintaining activity in later years is linked to successful ageing because of empirical relationships to positive self-perception, satisfaction with life, and development of competences, whereas from a societal perspective, active ageing implies usage of older people's life competences as a human capital of society—a societal imperative, particularly in times of demographic change but also more basically substantiated in an ethics of responsibility, intergenerational solidarity, and generation equity. We focus on the psychological construct of generativity which is interpreted as an aspect of the philosophical-anthropological category of joint responsibility. Our own research in Mexico and the Baltic States supports the notion that maintaining access to the public sphere and active engagement for others is a more basic individual concern than a life-stages specific developmental task. We report background and results of a Dialogue Forum Project Funding, a research cooperation between our institute and the Foundation Remembrance, Responsibility, and Future aimed to improve generativity in Belarus, Russia, and Ukraine by implementing and supporting local initiatives offering opportunities for intergenerational dialogue.

## 1. Active Ageing in Individual and Societal Perspective

Associating successful ageing with maintenance of activity has a long tradition in gerontology. Already in the 1960s, in the context of the classical controversy on propositions of disengagement theory, decreases in social roles and functions were interpreted as primarily reflecting prevalent misconceptions of old age and ageing, ageist stereotypes, and attitudes that contaminate external perception as well as self-conceptions and development of competences [1–4]. Although this pointed line of reasoning obviously neglects the significance of economic, political, and social structures as well as interindividual differences, the hypothesized relationships between role activity, self-concept, and satisfaction with life are still important for understanding positive or successful ageing [5, 6].

More recent gerontological theories elucidate that role activity in younger ages is a significant moderator of the relationship between older people's actual activity in specific social roles, satisfaction with these roles, and satisfaction with life. From the perspective of continuity theory [5] what predicts satisfaction and well-being is not the number of available roles and activities but the possibility to establish self-consistency via maintaining or substituting activities important for the self. Those older people who in younger ages identified themselves with specific social roles regularly benefit from continued role activity whereas others sometimes benefit from disengagement. Likewise, socioemotional selectivity theory [7, 8] elucidates that decreases in social contacts and social roles can have different outcomes depending on how older people succeed in satisfying individual motives for emotion regulation, identity, and information. Following this perspective the aforementioned motives change gradually over the lifespan. Because of a more limited future time perspective, emotional meaningful relationships become more and instrumental relationships become less important. Since people select among available relationships and activities, decreases in social roles sometimes reflect processes of optimization.

The modern understanding of active ageing is not least developed from a shift in research focus from questions

of old age to questions of ageing. Human development is conceptualized as a lifelong process and a dynamic and continuous interplay of age-connected and age-independent developmental factors, with people explicitly conceived of as agents of own development. Taking a primarily individual perspective, modern concepts of active ageing can be understood as preventive concepts. Due to continuous engagement in personally meaningful relationships and contexts and systematic use of chances and opportunities, physical, psychological, and social losses and deficits can be prevented or at least substantially delayed. Referring to more recent definitions of productivity—that is, considering intellectual, emotional, and motivational expressions of productivity in higher age-groups [9–11]—it is further argued that even when suffering from severe physical losses and independency, people still have options to use capabilities and options to be productive for others or society as a whole [12]. Taking a primarily societal perspective, modern concepts of active ageing can be understood as means to use life competencies of the old as a human capital for society. Particularly in times of population ageing society's prosperity cannot be maintained alone by utilization of the potentials of younger people. As a consequence of an aging labor force, companies' competitiveness depends more and more on their ability to recognize, support, and effectively use older employees' potentials for innovation and creativity. Design of protective working environments, adjustment of working conditions, and offering opportunities for extended vocational training belong to the criteria of the companies' "demographic fitness" [13]. However, societal usage of life competencies in older people must be restricted to the area of work, paid or nonpaid.

With the term human capital we refer to the significance of life competencies for society and culture, that is, processes of initiating societal and cultural change and the extent to which societal and cultural change is determined by life competencies of the old. With the term life competencies we refer to experiences, strategies, and knowledge systems that people have acquired in earlier phases of the lifespan and through lifelong learning process [14–17]. Life competencies are built up in the context of effective coping and do enable people to maintain or reestablish a personal satisfying perspective on their life when confronted with serious problems, tasks, and challenges in later years. Building up life competencies in earlier years is a basic requirement for successful development in advanced age, that is, effective coping with challenges and demands of life in old age. Such challenges and demands include practical and psychological as well as interpersonal and ethical issues. Consequently, our understanding of life competencies is not limited to physical and cognitive strategies and knowledge systems acquired in the context of educational and occupational activities. Life competencies are also reflected in ethical judgments and voluntary activities in service for other people as well as in the willingness and readiness to take responsibility for oneself, for others, or for society. Empirical findings show that active coping with developmental tasks and the chances and limits of life can lead to the establishment of "expert knowledge" or "wisdom" with respect to questions of life [18].

Proceeding from a comprehensive understanding of productivity, several possibilities of leading an active and productive life in old age can be distinguished. Being interested in development, living conditions, and vital interests of younger people, the transmission of information to younger generations and the self-responsible reflection of experiences and knowledge systems of younger generations are examples for intellectual and emotional productivity in old age, since intergenerational discourses can initiate emotional and intellectual differentiation in older and younger participants. Moreover, by leading an independent and responsible life, even when confronted with serious problems or borderline situations, older people can give a good example of how to cope with problems and difficulties for younger people.

A good example for a productive intergenerational dialogue initiated by older people's coping processes can be found in a study on identity and life review in Jewish emigrants and extermination camp survivors by Kruse and Schmitt [19, 20]. In this study, one principal way of coping with stressful reminiscence—whereby stressful memories generally became more intense with older age—was based on an individual need to engage for others as well as for the society as a whole. This way of coping reflected an intense preoccupation with the future time perspective of younger people and a commitment to the development of the younger generation as well as to sociocultural and political issues with the aim to sensitize for the societal as well as the personal responsibility to the maintenance of democracy and the avoidance of fascism and anti-Semitism. The people who obviously run through these coping processes attended history or ethics lessons at school as "contemporary witnesses of history" and contributed to a responsible handling with history that way.

Realizing the potentials of a modern understanding of active ageing distinctly depends from intergenerational solidarity with older people's respective aspirations, motivations, and opportunities explicitly reflecting integrative potentials of a given society [21, 22]. Supporting active ageing is motivated by the superior ambition to substantiate a society for all ages. Consequently, the guiding principles of active ageing [23] explicitly include rights and obligations. Following the principle of subsidiarity [24], society is considered to be responsible to guarantee adequate opportunities to develop, expand, and realize potentials of old age; older people are considered to be obliged to use the opportunities offered by society to realize a self-responsible and jointly responsible life.

Asking for humans' basic responsibilities we proceed from coram structure as a figure of thought. The Latin coram can be translated with to keep in sight, the term coram public with in front of the public (the community, the society, the world). Proceeding from the aforementioned figure of thought, three spheres of human responsibility are differentiated which—taken together—enlighten the meaning of old age for individuals as well as for societies. The first sphere of responsibility is individual self-care, that is, the person's responsibility for and against oneself. The second sphere of responsibility is individuals' joint responsibility, that is, their willingness to engage for others and society. The third

sphere of responsibility is individuals' obligation against God and creation, that is, joint responsibility for following generations, with those not yet been born included.

The concept of active ageing signifies a new understanding of ageing policy which—in distinction from a more traditional deficit- and welfare-oriented perspective—considers demographic change not as a basic problem but as a manageable challenge for societal development [25, 26]. As an answer to challenges of population ageing, the concept of active ageing refers to both an individual and a societal perspective: to actual and future resources and potentials of older people as well as to societal preconditions which have to be fulfilled for developing, expanding, and realizing potentials of older people.

Ageing policy is sometimes (mis)understood as social policy for older people, basically aimed to guarantee material security and health care. However, ageing policy is the entirety of measures focusing on maintaining or changing life situation of older people. Hence, questions of housing and transport as well as questions of education, employment, participation, and engagement are further important issues of ageing policy; ageing policy is a cross-section task since it is influenced by and has an impact on many other fields of policy: economic and financial policy, cultural and educational policy, and family policy. Emphasis of modern ageing policy is the basic requirement to offer older people equal chances for living a best possible independent and self-determined life within and for the respective society. Policy measures for older people should be inspired by the basic aim to establish a cultural context which allows for a competent and active ageing in the middle of the society and simultaneously can guarantee security and care for older people who suffer from impairment and disease. However, ageing policy must also compete with the task to deal adequately with needs, interests, and chances of younger and future generations. Supplies and rights in favor of the old as well as societal demands have to be reflected with regard to possible implications for the following generations. Aspects of generation equity are not only important for maintaining intergeneration contract—a basic cultural element of modern states—, but also for self concepts of older people. A positive impact on older people's self-concepts can be expected insofar as an intergenerational perspective enables them to find new sociocultural roles, that is, a basis for joint responsible living in old age. Equally important, that due to this perspective old age is increasingly integrated in the political and public sphere. To quote Arendt [27], the private dimension is enriched and expanded by the political dimension.

## 2. Generativity

From both an individual as well as a societal perspective leading a good life in old age refers to social participation—in the words of political scientist Arendt [27] to an appropriate access to public sphere, that is, opportunities to establish and maintain social relationships, to engage for the fulfillment of interests and preferences of self and others, to take responsibility, and to actively contribute to further

development of society. Most people experience respective opportunities as a source of belongingness, purpose and meaning in life, subjective well-being, and quality of life [19, 28, 29]. Individual's ability and motivation to empathize with other people, to engage for others, to contribute to the fulfillment of other people's needs, and to engage for society as a whole—joint responsibility [30]—are considered as a basic ethical category in old age.

In our own research we use the psychological construct of generativity which was described by Erik H. Erikson as the central topic of the seventh of eight psychosocial crises in lifelong development of ego identity and further developed by Dan McAdams, as an operationalization of the aforementioned ethical category.

According to Erikson [31], realization of generativity becomes an important developmental task in middle adulthood in the seventh of a total of eight psychosocial crises. Generativity can be defined as "concern in establishing and guiding the next generation" (page 267). As such, generativity is related to but also conceptually distinguished from the concepts of empathy, altruism, and intergenerational solidarity. In our understanding, the term empathy accentuates the "capacity to be affected by and share the emotional state of another", whereas the term altruism refers to "behavior that benefits a recipient at a cost to the actor" [32], intergenerational solidarity can be defined in terms of "social cohesion between generations" [33]. Generativity can reflect individual needs, social norms, or both. Ideally, generative behavior proceeds from an empathic understanding of the needs, interests, and preferences of the younger generation. However, concerns for the next generation do not necessarily reflect the perspectives of younger people. Although generative behavior often implies older peoples' willingness to take costs for the benefit of others, engagement for younger generations can reflect selfish as well as altruistic motives. Basically, generativity is both motivated by intergenerational solidarity and contributing to maintaining and strengthening intergenerational ties. However, generative behavior is not always requested and accepted by younger people.

Already Erikson accentuated relatedness of the term to productivity and creativity, even though his understanding of generativity primarily focused on family relationships, particularly bearing and raising children. However, in his psychoanalytically inspired biographies of Erikson [34] and Mahatma Gandhi [35] already considered extra-familial realizations of generativity in the public sphere which might be regarded as the most productive and creative forms of generativity. Today, generativity is no longer understood as a concept "within" the individual but as a relational and multiply contextualized construct that links the person to the social world.

Our understanding of generativity follows the conceptual and methodological framework provided by McAdams [36–38]. From this perspective there are two motivational sources of generativity, that is, cultural demand and inner desire. Cultural demand as a facet of generativity can be further explicated as reflecting age structure of society [39] and normative developmental expectations. In this context it should

also be considered that cultural demand for generativity can substantially change over time, for example, against the background of demographic change interest in possibilities and preconditions of development and effective use of strengths and potentials of old age has grown worldwide. But generativity is not only prompted by society, not only societies have benefit from generative action. Inner desire as a second motivational source of generativity refers to two complementary basic human needs, that is, a "need to be needed", to have meaningful relations to others, and a need for "symbolic immortality", that is, to invest resources and potentials into things that outlive the self. The aforementioned motivational sources of generativity are reflected in two further facets of generativity, that is, a conscious concern for the next generation and a commitment to take responsibility for the next generation. The translation of concern and commitment into generative action depends on what has been described by Erikson [40, 41] as "belief in the species", that is, "to place hope in the advancement and betterment of human life in succeeding generations, even in the face of strong evidence of human destructiveness and deprivation" [37]. Moreover, generativity is conceived of within the larger context of life-story theory of adult identity [36, 42]. From this perspective adults construct and try to live out a "generativity script" which not only reflects past generative action but is also important for current generative concerns and commitments as well as an understanding of what is worth to outlive the self and what can and should be transmitted to others to live on through generative efforts.

Generativity scripts are conceptualized as an important aspect of identity in higher age groups. In this context two aspects of identity become particularly important. (a) Identity—in the sense of an understanding a person has of himself and own development—is established in the context of narration. Adults define themselves and their position in society in terms of a life story that provides life with unity, purpose, and meaning [42–44]. Specific events and developments do not have an impact on individual identity in itself, instead they are selected from a magnitude of possible relevant events and developments (which moreover can be interpreted and evaluated in very different ways) and integrated into a coherent story (which starting from early adulthood regularly becomes a more and more definite story) which then builds the principal basis for understanding not only recent but also past events and developments. (b) Identity develops and becomes important in social interaction. Although referring to an individual understanding a person has of himself, identity in old age cannot be understood without considering social representations of old age and ageing, societal expectations and availability of social roles, and opportunity structures— for example, in the sense of a "generalized other" or a "Me" representing societal expectations and values [45]. As a consequence, processes of social change can have a profound impact on individual identity.

Understanding generativity as an important individual concern not only in middle adulthood but also in younger and particularly older age groups, the idea that generativity refers not only to an age-dependent developmental task but

moreover to the philosophical-anthropological category of joint responsibility is supported by two larger international studies of our institute.

In a comparative study we worked out together with colleagues from universities of Colima, Guadalayara, Juste and Madrid [46], we analysed relationships between generativity, optimism, and satisfaction with life in a sample of 3.308 subjects between 59 and 108 years of age, 1.506 from Mexico (394 from the region of Guadalayara, 387 from the region of Colima, 371 from the region of Armeria-Tecomán, and 354 from the region of Manzanillo), 1.200 from Spain (600 from the region of Alicante, 600 from the region of Extremadura), and 602 from Germany (region Heidelberg/Mannheim/Ludwigshafen). In each of the aforementioned 7 regions generativity was a highly significant predictor of optimism and satisfaction with life; regardless of the specific region considered, subjective health, financial resources, and family status could explain only for a much smaller amount of variance in optimism and satisfaction with life. These results support Veenhoven's model of the four qualities of life [47] which differentiates between "utility of life" (i.e., relevance for others) as a quality from "appreciation of life" (i.e., relevance for oneself), with these two qualities being independent predictors of subjective well-being. For all three countries no significant gender differences were found.

In an ongoing study in Estonia, Latvia, and Lithuania we analyze aspects of personal, social, and national identity, generativity, and perceptions of old age and ageing in three generations, that is, 15–25, 45–55, and 75–85 years old, in a sample of 360 subjects, 5 women and 5 men of each generation from each of the four biggest cities of Estonia (Tallinn, Tartu, Narva, and Kohtla-Järve), Latvia (Riga, Daugavpils, Liepaja, and Jelgava), and Lithuania (Vilnius, Kaunas, Klaipeda, and Siauliai). Results of this study show highly significant relationships between generativity, age stereotypes, and satisfaction with life, with generativity being an independent predictor of satisfaction with life after control for country, age, gender, national identity, and age stereotypes. In this study, women scored higher in generativity than men. Further analyses showed an interaction effect, indicating that the aforementioned gender effect is due to significant differences in the youngest age group. Our results on the relationship between gender and generativity are similar to those reported by McAdams and de St Aubin [36] for two US-American samples and support these authors hypothesis that "having children is more intimately linked with a man's generative concern than with a woman's (page 1008)". Given the cross-sectional nature of the data, more research is needed on the topic whether lower generativity scores in younger men is a predictor, a consequence, or both of not yet having children.

Going beyond theoretical contributions of Erikson and McAdams we argue that generativity is an important concern not only in third but also in fourth age, sometimes increasing vulnerability might even trigger individual motives for generativity [38]. In the context of our research on quality of life in people suffering from dementia [48] we found evidence for generativity as an important individual concern in a

substantial number of participants. Generativity concerns in these people became apparent particularly in reports about the disease to give closely related people insight into vulnerability to enable them to understand losses of control, challenging behaviors, and variation in emotions which care givers often attribute to inadequacy of own behavior, to give insight into processes of coping with border situations of human life, to inform about challenges, possibilities, and limits at the end of life, and more generally to contribute to a better understanding of people suffering from the disease.

## 3. Establishing Dialogue between Generations as a Strategy to Increase Generativity: Basic Ideas and Results of an Intervention Project in Post-Soviet Societies

In the following we report results of an intervention study aimed to increase generativity in post-Soviet societies by implementing and supporting local initiatives offering opportunities for intergenerational dialogue. This research was worked out in the context of cooperation between the Institute of Gerontology of the University of Heidelberg and the Foundation "Remembrance, Responsibility and Future" started in 2008.

The Foundation "Remembrance, Responsibility, and Future" was established in 2000, primarily to make payments to former forced laborers. The payments programs were completed in 2007. The Foundation's capital of EUR 5.2 billion was provided by the German Government and German industry. A total of EUR 358 million was set aside as Foundation capital in order to finance project support. The Foundation finances its long-term funding activities out of the income generated by this capital. Work of the foundation can be subsumed under three principal activity areas and objectives:

(i) critical examination of history: anchoring the history of forced labor under National Socialism firmly in the European memory, communicating the life experience of the victims, promoting understanding of the different portrayals of history in Europe, and raising awareness of the Jewish contribution to European history,

(ii) working for human rights: fostering commitment to democracy and human rights through history learning, initiating international projects that combat right-wing extremism, anti-Semitism, and modern forms of forced labor, which work to protect the victims, and developing capacity among the descendants of minority groups persecuted under National Socialism,

(iii) commitment to the victims of National Socialism: engendering respect for the life histories of those persecuted under National Socialism and strengthening their involvement in society across generations, promoting willingness to help the victims at local and international level, and encouraging the development

of models for providing humane support and care for the elderly.

Dialogue Forum Project Funding is a part of the third activity area "commitment to the victims of National Socialism." In the context of cooperation in this activity area the Institute of Gerontology is primarily responsible for three tasks:

(i) supporting implementation and optimization of intergenerational projects in Belarus, Russia, and Ukraine to increase respect for victims of World War II, to strengthen people's involvement in society, and to contribute to adequate societal use of individual potentials and experiences,

(ii) evaluating intergenerational projects to ensure that established intergenerational dialogues do not endanger individual and collective interests of the target group—for example, in terms of retraumatization or self-worth problems following from coping with aspects of own biography or transmission of knowledge and experiences,

(iii) transmitting ideas and effects of intergenerational projects into national and international scientific and political discourse to contribute to both development of new and sustainability of already established models and ideas for intergenerational projects.

In the context of Dialog Forum Project Funding three aspects of identity were considered to be particularly important.

(i) Identity develops and becomes important in social interaction. Although referring to an individual understanding a person has of himself, identity in old age cannot be understood without considering social representations of old age and ageing, societal expectations and availability of social roles, and opportunity structures [14, 44, 49]—for example, in the sense of a "generalized other" [45], a "looking glass self" [50], or a "situational self" [35] representing societal expectations and values. As a consequence, processes of social change can have a profound impact on individual identity.

(ii) Identity—in the sense of an understanding a person has of himself and own development—is established in the context of narration. Adults define themselves and their position in society in terms of a life story that provides life with unity, purpose, and meaning [42]. Specific events and developments do not have an impact on individual identity in itself, instead they are selected from a magnitude of possible relevant events and developments (which moreover can be interpreted and evaluated in very different ways) and integrated into a coherent story (which starting from early adulthood regularly becomes a more and more definite story) which then builds the principal basis for understanding not only recent but also past events and developments [51, 52].

(iii) Such a narrative identity can be reconsidered or even revised in old age for several reasons. From the tradition of psychoanalysis it has been argued that defense mechanisms might lose effectiveness in old age; others have argued that age-related impairments and losses can force people to give up "protective illusions" [53, 54]. From a sociological perspective it can be argued that cohort flow necessarily implies somehow new perspectives on society [55], and changes in individual ageing processes as well as changes in societal age structures [56]. As a consequence, successful ageing necessarily depends on mutual exchange in intergenerational relationships. Moreover, societal change in post-Soviet societies since 1991 can be expected to have important implications for self-understanding in older people since collective representations of other countries—the former enemies that have been defeated in World War II—and history as well as basic political and economic orientations were subject to substantial change and revision. After the breakdown of the former Soviet Union particularly the younger generation is more oriented towards capitalistic values and a model of society which is represented best by the United States and Western European countries.

(iv) Research on autobiographical memories suggests that events from adolescence and early adulthood are particularly important for narrative identity [57, 58]. However, intergenerational communication on such events is difficult in times of rapid social and political change.

Referring to the primary target group of intergenerational projects (i.e., victims of World War II in post-Soviet countries), four more specific aspects of identity and generativity that reflect insights, experiences, and hypothesis we developed during numerous interviews with members of our target group should be considered.

(i) The fate of former prisoners of war and forced laborers is still not adequately represented in popular accounts of national history. Considering self-understanding of older people in post-Soviet countries narrative identity implies that atrocities of war, losses, suffering, and deprivation of basic needs have not been useless or meaningless because of successful fighting against fascist enemies. For a substantial part of the population in post-Soviet countries former prisoners of war and forced laborers do not only failed to contribute to fighting back the threat of National Socialism, as collaborators they are even responsible for a longer-lasting war.

(ii) Before breakdown of the former Soviet Union, respect for the heroes of war was an essential part of collective consciousness of history and patriotism. Veterans regularly visited history lessons in school since it was considered important to transmit their individual experiences of war to younger generations. However, prisoners of war and forced laborers stand

for experiences that cannot be easily integrated into collective representations of war.

The cooperation between our institute and the Foundation Remembrance, Responsibility, and Future proceeds from the idea that the breakdown of the Soviet Union in 1991 and the fifth and sixth expansion of the European Union in 2004 and 2007 were not only accompanied by a development towards nationalistic sovereignty, democracy, constitutionality, and market economy but that in former Eastern bloc states and Soviet republics, questions of national and cultural identity have also gained in importance, became (again) subject of public discourse, and most importantly can—and sometimes even must—be answered differently. In this context it should be noted that in the former Soviet republics the decades of membership in the Soviet Union can be reconstructed as a loss of national independence, times of occupation, deportation, forced displacement, and attempted elimination of traditional language and culture as well as a progress in societal development giving raise to continued identification. In contemporary Ukraine about 75 percent of the national population speaks Ukrainian as first or second language, most people in the South and East prefer to speak Russian, whereas in the western part of the country most people prefer to speak Ukrainian. In contemporary Latvia about 30 percent of the population belongs to a Russian minority, 300.000 out of a total of 2.000.000 inhabitants do not have Latvian citizenship since they settled in Latvia before 1991 and have not passed naturalization proceedings afterwards. These two examples elucidate that national and cultural identity currently is a subject of controversy which must be clarified in intergenerational discourse.

It was expected that establishing informal contexts for intergenerational dialogue could contribute to realization of potentials of active ageing—namely generativity—in older people because the respective discourses not only result in a strengthening of own identity and related motives for joint responsibility. Local intergenerational projects should also offer opportunities to engage in new forms of generativity and experiences of being needed, accepted, and appreciated by others.

In 2009, 40 projects were implemented in Belarus, Ukraine, and Russia. 14 of these projects were evaluated by the Institute of Gerontology of Heidelberg University in a longitudinal research design consisting of 4 measurement points during a period of 2 years [59]. The central concept of project evaluation was generativity as an important facet of lifelong identity development, particularly in the form of older people to take responsibility for younger generations.

In evaluating intergenerational projects we used a combination of semistructured biographical interviews and psychometric scales for measurement of generativity and specific aspects of satisfaction and well-being in a sample of older people who participated in intergenerational projects. Additionally we assessed perceptions of generativity in a sample of younger project participants [59].

Concerning identity development, results indicate improvements in egointegrity, that is, older subjects'

awareness of self-sameness and continuity in life and ability to accept one's life as a whole, including lost opportunities and unfulfilled aspirations and expectations [40]. Scales for measurement of self-acceptance [60], purpose in life [60], and meaningfulness [61] as well as assessment of attitudes towards own ageing and lonely dissatisfaction [62] showed highly significant increases. Moreover, analyses of semistructured interviews showed that both younger and older people perceived intergenerational dialogue as a fruitful input for self-understanding, and national and cultural identity. Younger people stated that during the funding period they developed a deeper understanding of national history and contemporary culture. Besides feelings of mutual acceptance and appreciation, older people stated to be increasingly able to understand values, interests, and preferences in younger generations, continuity and change in societal development, and similarities and differences between subsequent generations.

In all three countries we observed substantial increases in scores on Loyola Generativity Scale (LGS, [37]) for both older and younger subjects. As hypothesized from our theoretical-conceptual understanding of generativity, older subjects' improvements in generativity were substantially correlated with self-acceptance, purpose in life, meaningfulness, lonely dissatisfaction, and attitudes towards own ageing.

At the first time of measurement LGS-scores for Ukrainian and Belarusian subjects were significantly higher than for Russian subjects. Improvement during the funding period was the highest in Ukraine. In Belarus and Russia we observed similar improvement; at measurement point 4 LGS-scores for participants from Russia approximated initial scores for participants from Belarus and Ukraine (see, [59, 63]). The aforementioned results support our hypothesis that societal demand for generativity might be particularly high when aspects of national and cultural identity are nationwide subject of controversy. This point elucidates the societal significance of potentials of older people in times of rapid social change.

In all three countries improvements in generativity are predicted by lower initial levels of generativity. Those who at least from a theoretical perspective of lifelong development are most in need of adequate intervention measures had the highest benefit from participating in intergenerational projects. Moreover, younger people perceived generativity in older people to be higher than generativity in their own generation—in our ongoing study in the Baltic states we find additional support for the hypothesis that younger people in post-Soviet societies explicitly appreciate (and do not neglect) knowledge and experiences as an important potential of old age. The latter result suggests that even if people of different generations have different perspectives on history and society there is no insurmountable generational gap. Overall, findings suggest that establishing dialogues between generations in the context of local projects is a promising measure to stimulate informal learning [15], to enhance generativity in both older and younger people, and to improve perceptions of older people's strengths and potentials in younger generations.

## 4. Concluding Remarks

In our view, the reported results of our research elucidate the societal obligation to shape public sphere on behalf of both older and younger generation in a way that— quoting Arendt [27]—maximizes opportunities for intergenerational encounters considering diversity, stimulating reflection of perspectives, discourse, and combined action, thereby enabling people to start something new—and this in the confidence to be recognized and accepted in one's peculiarity and to be appreciated for engagement for things and others. Establishing, maintaining, and strengthening of respective formal and informal context is considered a contribution to an age-friendly culture putting older people—their resources as well as their values, needs, and interests—in a similar way in the center of public sphere as younger people, enabling members of all generations leading lives in joint responsibility and social participation. Not only in Eastern Europe but also in Western countries, such a culture is still more a vision than reality, but nevertheless a basic imperative, not only in times of population ageing.

Development of an age-friendly culture depends on development of differentiated perceptions of old age and ageing. Older people need differentiated conceptions of old age and ageing for anticipation of developmental tasks, developing necessary resources, and using effectively existing resources in coping processes. Besides, also younger people benefit from differentiated conceptions of old age and ageing in terms of adaptive self-regulation, goal pursuit, and goal adjustment. Moreover, younger people need differentiated conceptions of old age and ageing for understanding and meeting adequately everyday interaction partners' specific limits, needs, strengths, and potentials.

As outlined in the 2nd International Plan of Action on Ageing [64], an age-friendly culture allowing for active ageing refers to building up a society for all ages. All ages have to be regarded as equal, not only with respect to rights but also with respect to obligations. Consequently, older people must not only claim their rights, rather they are—regardless if they are already retired or not—obliged against state and society. Considering demographic change, older people will have to take responsibility for further development of society. Societies are no longer able to relinquish the contribution of older people. Demographic change is irreversible. Whether European societies are able or not to grab the chance of using potentials of old age will be decisive for successfully meeting the challenges of globalization, structural change and international competition, and being prepared for necessities of reform and innovation to maintain prosperity.

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