The ageing population of China and a review of gerontechnology

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K. Chen, A.H.S. Chan. The ageing population of China and a review of gerontechnology. Gerontechnology 2011; 10(2):63-71; doi:10.4017/gt.2011.10.2.001.00 The older population has increased greatly throughout much of the world. China, with the largest ageing population in the world, will have to take population ageing very seriously due to the likely large negative impact on economic and social development. Gerontechnology, which combines gerontology and technology, can not only help to satisfy the demands and requirements of older people, but also has the potential to give support to caregivers and reduce spiraling health care cost. In this paper, we describe the general characteristics of the ageing population in China, and discuss the opportunity provided by gerontechnology when applied to facilitate successful ageing. Research and application of gerontechnology in China are still at an early stage and there are different kinds of barriers to the implementation process. Government, organizations, communities and researchers must collaborate to advocate and give full supports to the successful utilization of gerontechnology.

Key words: ageing population, China, gerontechnology

Population ageing is a process where the number and proportion of the aged increase relative to the total population as a whole[1]. At the moment, there is no standard numerical criterion for defining ageing or older people, but the United Nations has agreed that those of 60 years of age and over be referred to as the older population[2]. It is recognized that a society becomes an ageing society when the proportion of the population aged 60 and over accounts for more than 10 percent of the total population[2].

Population ageing in China

Since 2000, the speed of ageing of the Chinese population has surpassed the rate of population ageing of the world. Currently, China has a larger number of older people than any other country in the world. The number of Chinese people aged over 60 exceeded 166 million in 2010, accounting for 12.3 percent of the total population. And this number is expected to expand by three times to reach to 440 million by 2050[3] (*Figure 1*). Among the worldwide older age groups, the fastest growing sector is the oldest-old group, that is, those aged 80 or over. In the past five years, the increase in people aged over 80 in China was 25.4 percent, and that was higher than for the groups over 60 years old (17.1 %) and over 70 years old (15.4 %). By 2050, it is expected that about one in seven persons would be aged 80 or over (*Figure 2)*. Females will make up a significant percentage of the ageing population over the next 50 years. Among the oldest-old population (those 80 or over), there will be twice as many women as men.

Decreasing fertility rate along with lengthening life expectancy at birth are of course the primary causes of population ageing. According to data released by United Nations[3], during the last half century, the total

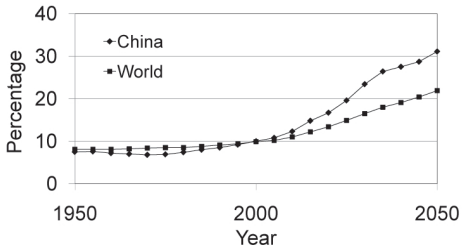

Figure 1. Proportion of population of 60 years or older to total population, China and World, 1950-2050[3]

fertility rate in China has dropped from 6.1 to 1.8 children per woman. This reduction was mainly due to the introduction of birth control policy in 1979 to restrict each urban couple to having only one child[4]. For the next half century, the fertility rate of 1.8 is projected to remain unchanged while the world level is 2.1.

Fertility rate is on a downward trend, but life expectancy at birth keeps increasing. Chinese population life expectancy has increased from 40.8 years in 1950-1955 to 73.0 years in 2005-2010, extending life expectancy by almost 33 years in the last five decades. In 2050, the life expectancy at birth is expected to reach to 79.3 years. Moreover, the gains in life expectancy are forecast to be more significant at the older age groups. The life expectancy at age 60 will rise from 19.4 years in 2005-2010 to 22.7 years in 2045-2050 (17.0% increase), from 12.4 to 14.9 years at age 70 (20.7% increase), and from 7.1 to 8.8 years at age 80 (23.9% increase). In terms of gender difference, women are reported to have a longer lifespan at all age groups. In the period of 2005-2010, women outlived men by 3.4 years, and it is projected that women's life expectancy at birth will exceed 80 years in 2045-2050.

According to the national population census report in 2000[5] and 'one-percent' national population survey in 2005[6], the distribution of ageing population also has geographic variations. The proportion of older people was higher in rural than urban areas. An important reason is the migration of working-age people out of rural areas into urban areas, which leaves proportionally more older people staying in rural areas[7].

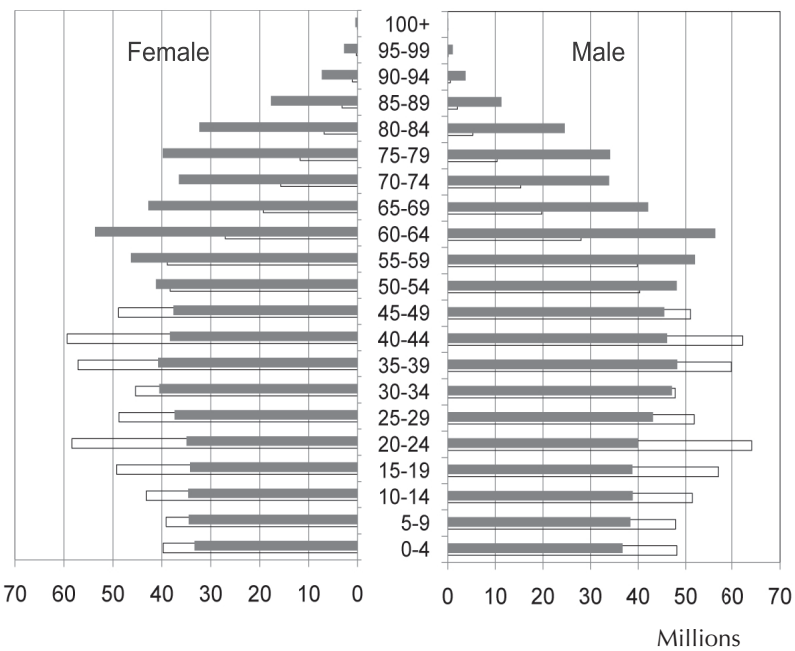

Figure 2. Population by five-year age group and gender in China, 2010 (white) and 2050 (grey)[3]

The ageing of populations also varies between regions. The proportion of the aged population declines from the southeast coast (which is an economically more developed area) inland to the northwest. In the eastern regions of Shanghai, Jiangsu, Beijing, Zhejiang and Tianjin the proportion of the aged population exceeded 12 %, while in western regions as Xinjiang, Qinghai, Tibet, and Ningxia, the proportion was only around seven percent in 2000.

Current status of older Chinese

The National Bureau of Statistics of China conducted a 'one-percent' national population sample survey at the end of 2005, covering a population of 17.05 million (1.3 % of the total population)[6]. The results showed that most of the older Chinese were in good health. Of those aged 60 and over, 60.3 percent reported that they were in good health. As expected, the self-reported health condition decreases with age. Those who reported they were in good health dropped to 28.7 percent among people at age over 80.

The illiteracy rate among older population has declined dramatically in the past 20 years[1]. Even so, the education level of the aged population is still low. According to the 2005 sample survey, nearly 42.4 percent of older people never had any education, 37.6 percent had only primary education (first six years of nine years compulsory education in China), 12.2 percent had junior secondary education (last three years of compulsory education), and the remaining 7.8 percent had received senior secondary education and above (three years of high school education).

The proportion of the older men who had received education was significantly higher than that of women. In addition, the young-old group (60-64) had higher education level than the middle-old (65-69) and the old-old (>70) groups. The low education level of Chinese seniors was due to the Cultural Revolution from 1966 to 1976, when the education system collapsed and all school teaching was suspended[8].

The labour force participation rate among people 65 years or older in China has been falling from 29.3 percent in 1950 to 14.5 percent in 2010[1]. Furthermore, the reduction in labour force participation is significantly greater for men (from 56.0% in 1950 to 22.9% in 2010) than women (from 10.0% in 1950 to 7.2% in 2010). The current mandatory retirement age in China is 55 for male workers and 50 for female workers, with a five-year extension for officials and professionals with special expertise. Xie[9] reported that China has strikingly lower retirement ages than other countries.

In China, 70.0 % of older people live with their children or relatives, compared to only 0.8 percent living in institutions[2]. The income to cover cost of living for many Chinese seniors was dependent on their family members, accounting for 47.0 % of the total; followed by those living on income from work (27.5%), retirement wage and pensions (21.7%), and other sources (3.8%). This situation implies that the family rather than the government is taking the primary responsibility for supporting the older people. Currently, the majority of the couples, who adhered to the one-child birth control policy in the seventies, are becoming old. The one-child generation is therefore confronted with the considerable burden of providing support for his or her two parents and four grandparents - a phenomenon known as a 'Four-Two-One' problem[10].

As a consequence, the impact of population ageing is significant and profound. Population ageing will influence all aspects of life, including economic growth, savings, investment and consumption, the labour market, pensions, social security program, taxation, health care, family composition, living arrangements, and migration. The demographic characteristics of China are more similar to the developed regions of the world than to the less developed regions, but the economic development and social welfare systems of China are at levels more typical of the less developed regions. This predicted shift in demographic structure has caused China to be characterized as a country 'becoming old before it gets rich'[10]. Meeting the ageing-related demands such as social security systems, health care and community services with a relatively low level of economic development will be a tough challenge for China.

Gerontechnology

Gerontechnology has the potential to help older adults to maintain physical fitness, cognitive function and social activity, as well as providing opportunities for increasing in-

Table 1. Summary of technologies encountered and used by older people in China

Category	Functions	Technologies
Housing and daily living	Convenience, safety, security, comfort and entertainment	Security alarm, burglary alarm, locking device, washing machine, microwave oven, intelligent control systems, Smart home, personal response systems
Communication technology	Communication and transfer information	Mobile phone, video telephone, e-mail, computer-based communication devices, Internet, Instant Messaging, Web 2.0
Mobility and transport	Compensate or prevent physical limitations in personal mobility	Handrails, canes, walkers, wheelchairs, barrier-free environments, elevators, electronic stairs, intelligent transportation system, public transportation systems (buses, subways, trains, ships and airplane)
Health technology	Home healthcare, Medical assistance	Electronic care surveillance devices, wireless sensor networks, advanced imaging system, smart implantations, miniature robots, biocompatible materials and substances, hearing aids, vision aids, memory aids
Education and recreation	Education and entertainment	E-learning, multimedia learning platform, electronic reading or hearing machine, computer games, camera, tape recorder, DVD/CD Player, satellite TV, handheld games machine

dependence and productivity[11,12]. Therefore, if older Chinese are able to use technology, the economic and social burdens of families, communities and the country may be lowered significantly. Obviously, there will be a huge potential market in the future for the development of gerontechnology and the results could significantly influence many aspects of life in countries with ageing populations. Researchers have classified gerontechnology application areas into five categories: (i) housing and daily living; (ii) communication; (iii) personal mobility and transportation; (iv) health and home care; and (v) education and recreation[12-15]. In this paper, we summarize the technologies that have been or can be utilized by older people with particular emphasis on the Chinese (*Table 1*).

Housing and daily living

Studies have shown that older adults prefer to 'age in place', that is to remain in their own homes confidently and comfortably for as long as possible[16]. Technology can be supportive for daily life, as technological products and services can compensate functional impairments and enhance independence[13,17,18]. Existing contributions of gerontechnology in this category are focusing on convenience, safety, security, and comfort[12,17]. Service robots can perform daily tasks and provide services for the seniors[19]. A cooking robot has been developed to cook and deliver Chinese dishes automatically for older people and disabled people[20]. The relatively new 'smart home' concept focuses on home automation services which can control and operate digital devices locally or remotely[21]. A smart home security system allows the homeowner to view visitors on a camera, speak via a microphone and remotely open the door. Other systems such as temperature monitoring, automatic lighting and reminder system announcing upcoming appointments or events, assist older people in leading safe and convenient lives in their own homes[22,23].

Senior Citizen Home Safety Association in Hong Kong introduced a 24-hour Personal Emergency Link Service (PELS) in 1996, which allows a person to gain access to emergency assistance when they need help or medical service, by pressing an alarm button or by use of monitored wireless video cameras[24]. Leung[25] reported that the PELS in Hong Kong has developed from an emergency assistance service into a holistic personal care service by integrating secretarial and reminder services, health advice service, emotional support, and communication services.

Communication technology

Communication applications can remotely connect older people with family members and friends, facilitate relationships and social contacts when at homes, and help to alleviate social isolation. The Internet is playing an increasingly important role in encouraging people to participate in social activities[8,26,27]. In China, older adults are increasingly using the Internet. From 1997 to 2010, Internet users aged 50 or over increased from 29,768 to more than 29 million[28]. Xie[9] reported that for older people, negative feelings can be reduced and attitudes towards post-retirement life can be improved by using the Internet. Learning to use the Internet has the potential to improve self-esteem and self-image and give other people a more positive view of the aged, and make life after retirement more meaningful. The online activities and interactions also can facilitate and strengthen the offline relationships. Through the Internet, older people can seek out health information, purchase products, gain access to e-learning, and engage in social networking[29-31]. Mobile phones with simplified interface and specific functions (i.e., emergency keys, health care reminding) for older adults can meet the elderly usage needs[32,33].

Personal mobility and transportation

Mobility is an important prerequisite for an older person to live independently[34]. The notion of mobility refers to the ability of freely getting around in one's daily environment and moving across large distances by private or public transport[35]. Handrails, canes, walkers, wheelchairs, and barrier-free environments are compensatory in allowing the older people to retain their personal mobility[14]. Common forms of transport providing mobility for older people are private cars and public transportation systems. Vehicles with intelligent transportation systems, such as Geographic Information System (GIS), Global Positioning System (GPS), distraction management systems, and collision avoidance warning systems can improve safety and enhance the performance of older Chinese drivers[36].

In public transport systems, access for older people can be provided by reducing step heights and providing escalators and moving walkways[37]. The Walking Assistant Robots (WARs) developed by Shanghai Jiao Tong University (China) provide assistance to older people on sitting, standing, walking, detecting and avoiding obstacles, and tracking users' locations[38].

Community-based fall prevention interventions, such as education programme, in-home hazard assessment, and community setting modification were found to be effective to reduce the incidence of falls in older urban Chinese[39].

Health and home care technology

Decline of physical and cognitive functions due to ageing and sickness can be partially compensated by assistive and adaptive medical technologies[12]. For example, memory aid systems can provide support for older people with cognitive and mental impairments by cueing and reminding them about medical schedules and upcoming appointments[40-42]. Other assistive technologies used by older Chinese adults include hearing aids[43] and low vision aids[44]. The active training machine enables older adults to do physical exercises and thereby to improve the muscle strength[45].

The development of telecommunication can remotely connect patients with health professionals and care givers, and thereby help to accomplish the shift from traditional institution-based health caring to home-based or community-based health care[40,46]. Wireless sensor and networking techniques have been used in Beijing (China) to facilitate physiological monitoring and healthcare delivery in the domestic environment [47,48]. Smart wireless sensors installed in the home or carried by a person can measure physiological parameters (blood pressure, heart rate, and EEG, etc.), monitor the presence and motion of the person, and then transmit the data to the monitoring center[47].

The distribution of medical resources and equipment was imbalanced in China, with urban areas benefiting more than rural areas[4]. Telemedicine provides an opportunity to help older Chinese in rural areas to gain better access to health services[46,49].

Education and recreation technology

With educational technology, older people in China whose education was interrupted during the Cultural Revolution or those who never had the chance to receive an education, can pursue knowledge easily and conveniently. E-learning is 'electronic learning which comprises a wide set of applications and processes that include web-based learning, computer-based learning, and virtual classrooms'[50]. It has proven to be a cost-efficient and highly flexible training tool.

Digital broadcasting (webcasts, teleconference) and multimedia which incorporates audio, video, and images as well as text resources can be used to improve learning effectiveness[51]. Some organizations in China, like OldKids, and CyberSenior Network Development Association Limited (Cybersenior), have been making efforts to promote IT awareness and accessibility in the older population by providing training courses[52,53].

Computer games, programs for creating visual art and music, VCD/DVD players and sport technologies can be used by older adults for leisure or entertainment purposes[14,54]. Leung[54] found that the use of new media technologies, especially listening to music on CD/MD/MP3, could enhance older person's social support and quality of life. Video games also can be used to improve seniors' perception and cognition [55,56]. A longitudinal study indicated that participation in intellectual activities, such as reading, writing, playing board games and handicraft, is associated with less cognitive decline among older Chinese[57].

Existing barriers and future work

There have been many attempts to implement gerontechnology in homes and working environments in Europe and the USA, however, the application of gerontechnology in China is at a very early stage. Although older people in China are increasingly using technology, the usage rate of new technology is still low compared to other countries. In June 2010, only two percent of Chinese Internet users were over the age of 60[28]. At the same time the Internet usage rate by people over 65 in Europe was 10 % in 2007, 35 % in USA, and nearly 50 % in Japan[58].

A major barrier faced by older users is accessibility[59]. Cost is another barrier and is likely to be the main concern in adoption of technology by older people. Internet and telecare services are expensive for old users[8,30]. As the main cost of living for older adults in China is borne by their children, the aged may not have access to any extra money to be able to afford to use technological products and services. Financial status will be a serious constraint limiting the use of technology by older people in their daily life.

Products and services customized to older users, with, for example, the characteristics of larger print, larger buttons, sound amplification, and low memory or cognition load, etc., are so far not well developed in China.

Lack of environmental support also hinders the use of technology by older people[53]. As many older people have a low education level, they do not have enough knowledge to use advanced equipment and systems. At present, there are no legal provisions or policies which favour the deployment of gerontechnology in China. Many older people appear to be content with their lives without the use of technology, probably because they know little or nothing about the technologies available or they do not realize or perceive the potential benefits of technologies that they do know about. In order to raise awareness of gerontechnology and put it within the reach of older people, the Chinese government and related agencies or organizations could follow the lead of successful practices in other coun-

tries, such as subsidizing technology usage activities, establishing more facilities in communities and public locations, and offering training courses tailored to the aged, etc[29].

In conclusion, for China, further work can focus on two aspects. One is optimizing the design of technology products and services to meet the needs of older Chinese people. Researchers, engineers and manufacturers should strive to improve the design and usability of technological devices and systems. The other aspect is to provide full support to efforts to make gerontechnology accessible and within reach of older Chinese. The government must establish policies to encourage older people to utilize technology, and foster a social environment that is conducive to helping them to use gerontechnology.

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