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CONTENTS

Volume 5, Number 5, 2023

LETTER

COVER PHOTO OF THIS ISSUE

Population ageing and shrinkage overlap and significantly impact society through health issues. There is no single, universal solution to address the challenges of population ageing and fertility rate decline. Rather, the key to success lies in implementing long-term, future-oriented planning that considers the unique context of each country. It is essential to begin this work early to achieve good outcomes. (Text from Hiroki Nakatani)

This photograph was captured during a health survey for elderly individuals in Cambodia. (*Photo from Kao Sovandara*)

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EDITORIAL
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Ageing and shrinking population: The looming demographic challenges of super-aged and super-low fertility society starting from Asia

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Abstract: The world is generally getting more prosperous and healthier, and people live longer. Japan, with the world's most advanced population ageing, has made various efforts over the past half-century to prepare for the ageing society. Globally, many countries observe today's rapid demographic changes accompanied by low birth rate and start acknowledging population shrinkage as a looming challenge beyond that of population ageing. The world will face dual challenges of population ageing and shrinkage, but these two issues have been considered in isolation. In addition, the progression differs from region to region and country to country, preventing policymakers from taking a future-back approach to address the core challenges. This issue of *Global Health & Medicine* carries two valuable articles on population ageing and related policies reported by staff members of the WHO Western Pacific Regional Office (WPRO) and the United Nations Population Fund (UNFPA). This paper will consider the importance of ageing and low fertility rate (declining birthrate) as global issues by placing the WHO and UNFPA articles in a broader context. Population ageing and shrinkage overlap and significantly impact society through health issues. Still, the impact on countries, regions, and the world will become obvious with a time lag. Therefore, this paper advocates analyzing and critically reviewing the experience of countries in which demographic changes are already well advanced, and sharing them with the world. This will contribute significantly to those regions and countries that will walk the same path in the future.

***Keywords*:** healthy ageing, population ageing, population shrinkage, demographic transition, international collaboration

Introduction

The world is generally getting more prosperous and healthier. However, there are also many who are left behind, and the basic idea of Sustainable Development Goals (SDGs) is that multi-sectoral cooperation is needed to solve such problems. The financing and supply of healthcare have to address demographic changes such as population ageing, which is recognized as a problem. Japan with the world's most advanced ageing population has made various efforts over the past half-century to prepare for the ageing society. However, this issue is not exclusive to Japan. As the elderly population grows in many countries, international efforts to raise awareness of ageing issues and share best practices and research results have led to the adoption of the United Nations (UN) Decade of Healthy Ageing Resolution (*1*) in 2020. Another critical step is the agreement at the G20 Finance and Health Ministers' Meeting in 2019 (*2*) under Japan's leadership to strengthen cooperation between the health and finance sectors to promote universal health coverage, including addressing the immediate issue of rising healthcare costs. The COVID-19 pandemic coupled with the economic, food, and energy crises triggered by the invasion of Ukraine have shifted global health concerns towards manageing health crises in complex situations. Consequently, the issue of ageing was not a significant topic at the recent G7 summit hosted by Japan (*3-5*). Even under these circumstances, Prime Minister Kishida of Japan, in his policy speech at the beginning of 2023, addressed the issue of declining birthrate as a significant policy issue alongside the challenging international environment (*6*). This reflected a sense of crisis over the released figures (*7,8*) that Japan's population had shrunk by 780,000 in 2022, the largest decline ever recorded, together with a drop in number of births to below 800,000 as a result of further acceleration of total fertility rate decline to 1.27. Such sharp declines of population and births are now perceived as a critical issue, and Yamazaki's novel entitled "Jinko Senryaku Houan (Draft Population Strategy Legislation)" (*9*) became a popular book.

In this issue of *Global Health & Medicine*, two valuable articles on population ageing and related policies reported by the staff members of the WHO Western Pacific Region Office (WPRO) and United Nations Fund for Population Activities (UNFPA) are published (*10,11*). This paper will consider the importance of ageing and low fertility rate (declining birthrate) as global issues by placing the WHO and UNFPA papers in a broader context.

WPRO and UNFPA articles

Asia is undergoing dynamic economic and social development, and at the same time experiencing major changes in demographic composition and health services. The WHO Western Pacific Regional is a region rich in diversity with a large territory and big population, including Japan, China, Korea, most of the ASEAN countries, and Oceania and Pacific Islands countries. Meanwhile, the UNFPA Regional Office for Asia and the Pacific covers the WHO Western Pacific Regional, in addition to ASEAN countries such as Thailand and Indonesia, and the WHO South-East Asia Region including India. The two insightful articles published in this issue are summarized below.

The WPRO article "Promoting health ageing in the Western Pacific: A mini review of good practices and policy responses" (*10*) discusses the rapid ageing of population in some parts of the Western Pacific region with Japan leading the way, and the major challenges of reforming healthcare systems. At the initiative of Dr. Takeshi Kasai, former Regional Director of WPRO, the Office has developed a region-wide health system reform plan called "For the Future" (*12*). As a part of this plan and in response to the UN Decade of Healthy Ageing, WHO has developed the Regional Action Plan on Healthy Ageing in the Western Pacific Region (*13*) to support countries in achieving a healthy ageing society. This paper covers regional efforts in the form of introducing some best practices of member states within the framework of the following five pillars: *i*) transforming societies as a whole, *ii*) transforming health systems to address each individual's lifelong health needs, *iii*) providing community-based integrated care, *iv*) fostering technological and social innovation, and *v*) enhancing research, monitoring and evaluation.

The UNFPA article "Low fertility and fertility policies in the Asia-Pacific region" (*11*) explores the low fertility rate, which in many cases occurs at the same time as population ageing. The report specifically examines the challenges faced by Asian countries that have experienced a significant reduction in fertility rate despite various interventions aimed at preventing or reversing this trend. The paper also analyzes the factors that contribute to low fertility, including the unequal distribution of domestic work responsibilities between men and women, which has been slow to change in comparison to the increase in female labor force participation. Additionally, the high costs of education and housing are also contributing factors. The paper also examines the impact of different policies that address social issues, such as labor and family policies. These policies include measures to support dual-earner households, such as promoting parental leave, expanding daycare centers, and offering flexible working hours. Additionally, the paper examines the effectiveness of financial support policies, particularly those that provide spot economic assistance such as maternity benefits. Both papers concur that there is no single, universal solution to address the challenges of population ageing and fertility rate decline. Rather, the key to success lies in implementing long-term, future-oriented planning that considers the unique context of each country. It is essential to begin this work early to achieve good outcomes.

National Academy of Medicine and UN Population Division publications in 2022

In 2022, the deliverables of two significant initiatives that commenced before the COVID-19 pandemic were published successively. They are the Global Roadmap for Healthy Longevity (*14*) published by the National Academy of Medicine and World Population Prospects 2022 (WPP 2022) (*15*) published by the UN Population Division. The main points of both reports are summarized below.

First, the Global Roadmap for Health Longevity identifies the promotion of healthy lifestyles, reduction of health inequalities, promotion of lifelong learning and capabilities, use of technology, and policy change as key elements for achieving healthy and active lives. Then, the report presents an immediate five-year action plan and a roadmap to reach the 2050 goal. The basic concept of the roadmap is shown in Figure 1. Healthy longevity is defined as a situation in which individuals and society are healthy and well, people are active to the best of their abilities, and are engaged in society.

The basic concept is that human, financial, and social capitals are vital resources that eventually enable and advance healthy longevity. Their enabling factors are work, physical environment, social infrastructure, and health systems. At the same time, the factors that disrupt this virtuous cycle should be alleviated.

Next, the WPP 2022 is a breakthrough in that it not only changes the method of population estimation from the five-year intervals used previously to one-year intervals of age and time, but also adopts a probabilistic model and presents the data for each country. However, the main message of the report in practical terms is not necessarily clear. Hara summarized the report in his recent book (*16*) as follows. The projections of continued population growth to 8 billion by the end of 2022 and 10.35 billion by the beginning of the 22nd century are

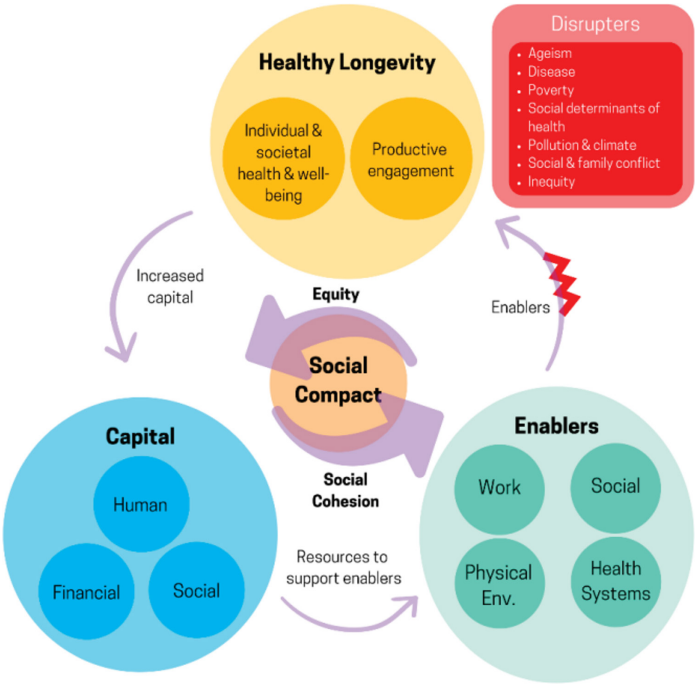

Figure 1. The virtuous cycle of healthy longevity. Data Source: *https://nap.nationalacademies.org/catalog/26144/global-roadmap-for-healthy-longevity* (accessedSeptember 26, 2023). Used with permission of The National Academies Press, from National Academy of Medicine 2022, *Global Roadmap for Healthy Longevity*, Washington, DC: The National Academies Press, Copyright 2022; permission conveyed through Copyright Clearance Center, Inc.

within the expected ranges and would probably attract only transient interest. The real value of the report is not merely presenting that the world population will grow by an additional 2.3 billion people, making the number of humans on the planet 1.3 times larger than it is today, but showing the trends of demographic changes in different age groups and geographic regions. When examining the breakdown of population growth, it is evident that the largest increase will be seen in the older population aged 65 and over, which is estimated to be 1.71 billion people or 71.8% of the total population growth. On the other hand, the population of children under the age of 14 will decrease by 310 million. Sixty-one countries, mainly in Europe and Asia, will lose 1% or more of their population by 2050. The world population will peak at 10.43 billion in 2086 and then begin to decline. In other words, like Japan, the world's population is expected to decrease due to the ageing of society with more deaths and fewer births in the future. Geographically speaking, the working-age population will continue to increase only in sub-Saharan Africa, which is why the 22nd century is expected to be African century.

Table 1 shows the past, present, and future world population based on the original data used in WPP 2022. Looking at the world in 2050, the population will continue to grow, albeit at a slower pace, with average life expectancy of 77.2 years (equivalent to that of [≈] Japan in 1983) and an older (aged over 65 years) population of 16.5% (≈Japan in 1983). On the other hand, the decline in the Japanese population will accelerate, with life expectancy projected to reach 88.3 years and the older population to increase to 37.5%, which is close to the peak. Population growth in Asia will have almost stopped, with life expectancy of 79.5 years (≈Japan in 1993) and an older population of 19% (≈Japan in 2002). In Europe, the population will have begun to decline, with average life expectancy of 83.8 years (≈Japan in 2014) and an older population of 28.9% (≈Japan in 2018). In Africa, however, the average life expectancy will be 68.3 years (≈Japan in 1961) and the proportion of older population will be 5.9% (≈Japan in 1961). These figures would imply that by 2050, Europe would resemble the present-day Japan; while Asia would resemble Japan at the end of the 20th century when the economic bubble burst; and the world, meanwhile, would resemble Japan on the eve of the economic bubble in the 80's, whereas Africa would resemble Japan during the phase of rapid economic growth in the 60's.

As the progress of population ageing differs from region to region and from country to country, it is important to analyze what Japan and Asia, which are undergoing drastic changes in population size and composition, did or did not do to solve the ageing problem and the outcomes of their responses, and to present the results to the world. Sharing the major lessons of a social experiment that cannot be tested in a laboratory – namely, the response to demographic change – is a way to contribute to the new global challenge of ageing.

Ageing and the shrinking World

When health improves rapidly, as in Japan after World War II, even though the birth rate decreases, the population grows, and the working-age population expands, thus increasing economic activity and accumulating social capital (*17*). This also creates a virtuous circle that will lead to investment in health. However, as the population ages and fertility declines, lifestyle-related diseases will replace acute conditions as the leading health challenge. These changes in

Table 1. Past, present, and future world population

Item	Year	Total Population (thousands)	Median Age (years)	Population Growth Rate (%)	Population Annual Doubling Time (years)	Total Fertility Rate (live births per woman)	Life Expectancy at Birth, both sexes (years)	% 65+ Population
WORLD	1950	2,477,675	22.2	1.73	40.0	4.86	46.5	5.1
	2000	7,804,974	29.7	0.92	75.5	2.35	72.0	6.9
	2050	9,687,440	35.9	0.45		2.15	77.2	16.5
	2100	10,355,002	42.3	-0.11		1.84	82.1	24.0
Japan	1950	83,656	21.2	1.65	42.0	3.66	59.2	4.9
	2000	125,543	48.0	-0.48		1.29	84.7	17.8
	2050	104,140	53.6	-0.68		1.47	88.3	37.5
	2100	73,846	54.4	-0.55		1.55	94.2	38.7
ASIA	1950	1,365,953	20.6	1.90	36.5	5.71	42.0	4.2
	2000	4,647,858	30.8	0.71	98.2	1.98	73.7	5.8
	2050	5,290,145	39.8	0.11		1.85	79.5	19.0
	2100	4,684,822	46.9	-0.45		1.71	85.5	29.2
AFRICA	1950	225,120	18.1	2.14	32.5	6.59	37.6	3.3
	2000	1,344,070	18.6	2.44	28.4	4.36	62.2	3.5
	2050	2,465,755	23.9	1.56	44.4	2.87	68.3	5.9
	2100	3,917,077	35.1	0.37		1.99	74.9	14.5
EUROPE	1950	547,304	27.8	0.88	78.8	2.70	62.8	7.9
	2000	746,597	41.5	-0.10		1.47	77.7	19.1
	2050	704,172	47.3	-0.33		1.63	83.8	28.9
	2100	587,362	49.6	-0.29		1.67	90.1	32.9
NORTHERN AMERICA	1950	160,754	29.0	1.65	42.1	2.97	68.0	8.1
	2000	373,272	37.7	0.37		1.63	77.9	16.4
	2050	421,001	43.4	0.19		1.68	84.0	23.8
	2100	447,907	47.4	0.05		1.69	90.0	30.6

Data Source: *i*) WPP 2022 File: POP/06-1: Percentage of total population by select age group, region, subregion and country, annually for 1950-2100. Estimates, 1950–2021. *https://population.un.org/wpp/Download/Files/1_Indicators%20(Standard)/EXCEL_FILES/2_Population/WPP2022_POP_F06_1_POPULATION_PERCENTAGE_SELECT_AGE_GROUPS_BOTH_SEXES.xlsx* (accessed September 26, 2023); *ii*) WPP 2022 File: GEN/01/REV1: Demographic indicators by region, subregion and country, annually for 1950–2100. Estimates, 1950–2021.

disease structure have led to the realization that the current healthcare system that specializes in diagnosing and treating disease needs to be transformed towards maintaining people's health. Hence, a shift from a "sick system" to a "health system" is being sought. Specifically, rather than waiting for people to become ill, hospitals and clinics are using existing community groups, networks, and events (such as schools, workplace, and neighborhood associations) to provide proactive advice to healthy people and to reduce negative social and environmental factors that are the real causes of illness (such as social isolation, lifestyle, and lack of interest in health). Furthermore, as ageing of society progresses, the idea evolves from healthcare to welfare and eventually to the need for a society-wide approach to reform at a scale involving living, finance, and social dimensions, which enables people to live long and active lives in their old age. With this background, the WHO documents (*18,19*) on healthy ageing also reflect these trends and promote integrated care for older people (ICOPE) and age-friendly environment as priority activities. These call for major changes in health resources. As long as the economy is expanding or the results of economic expansion are sustained, it is possible, albeit with some difficulties, to facilitate this shift through various government subsidies and other means. However, reforming the health system will be more complicated if the population is declining, especially if this accelerates to the point of contraction. In other words, if the working-age population declines and social capital reaches a situation where the capital is being consumed instead of accumulated, contraction and restructuring must always be carried out in response to the shrinking population. However, the resources that can be allocated for this purpose are minimal. Developing new social assets and renewing them systematically is expected to be even more challenging than it is today.

The need to consider the time axis

First, let us discuss the stable period and transition period of the population. Figure 2 is a chart based on the population proportions by age group in Japan obtained from the WPP 2022 source data. From 1950 to around 1970, young people aged 14 and below decreased rapidly, and the number of older people aged 65 and above increased slowly. Thus, the proportion of the dependent age group declined consistently. Since then, the number of young people has continued to decrease, while the number of older people has increased, resulting in a net increase in the dependent population. The proportion of the dependent population aged 0 to 24 and aged 75 and over will stabilize at 45%, and the ratio of the working age population aged 25–74 will stabilize at around 55%. This transition period will likely continue for the next 30 years and require continuous reforms. Then, the overall demographic composition will remain stable but we will face harsh reality that the current population of 125.5 million is expected to shrink by about 40% to 73.8 million by 2100.

To achieve a successful transition and sustain the

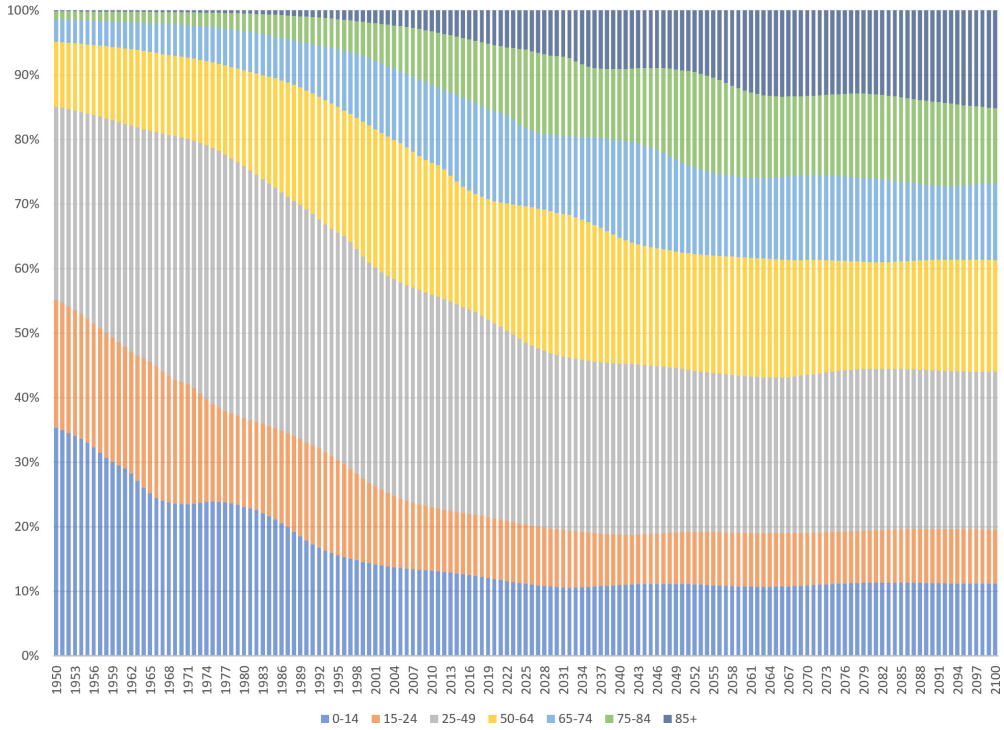

Figure 2. Age composition of Japanese population. Data Source: WPP 2022 File POP/06-1: Percentage of total population by select age group, region, subregion and country, annually for 1950–2100. Estimates, 1950–2021. *https://population.un.org/wpp/Download/Files/1_Indicators%20(Standard)/EXCEL_FILES/2_Population/WPP2022_POP_F06_1_POPULATION_PERCENTAGE_SELECT_AGE_GROUPS_BOTH_SEXES.xlsx* (accessed September 26, 2023).

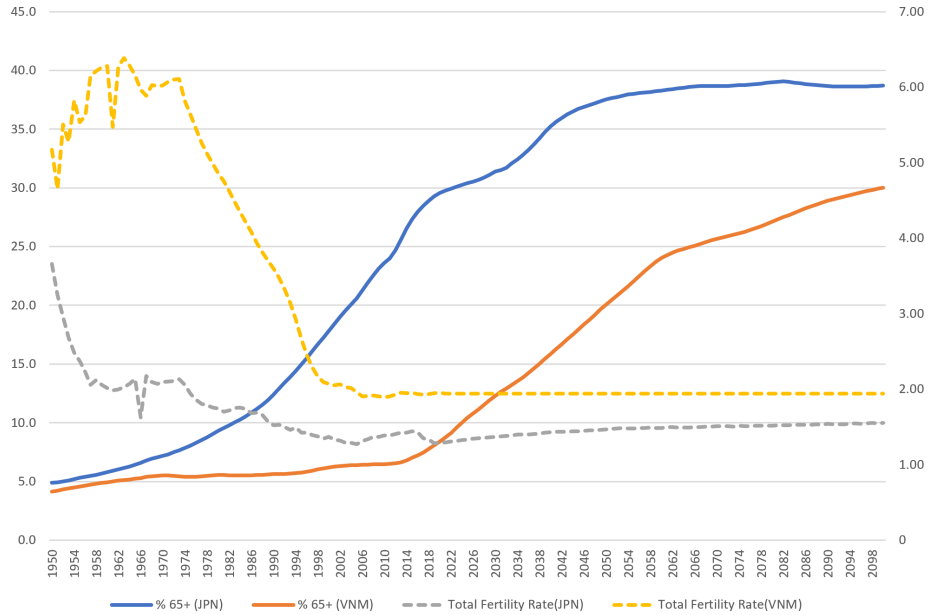

Figure 3. Comparison of percentage of 65+ population and total fertility rate: Japan and Vietnam. Data Source: *i*) Percentage of 65+: WPP 2022 File POP/06-1: Percentage of total population by select age group, region, subregion and country, annually for 1950-2100. Estimates, 1950–2021. *https://population.un.org/wpp/Download/Files/1_Indicators%20(Standard)/EXCEL_FILES/2_Population/WPP2022_POP_F06_1_POPULATION_PERCENTAGE_SELECT_AGE_GROUPS_BOTH_SEXES.xlsx* (accessed September 26, 2023); *ii*) Total fertility rates: WPP 2022 File GEN/01/REV1: Demographic indicators by region, subregion and country, annually for 1950-2100. Estimates, 1950–2021. *https://population.un.org/wpp/Download/Files/1_Indicators%20(Standard)/EXCEL_FILES/1_General/WPP2022_GEN_F01_DEMOGRAPHIC_INDICATORS_REV1.xlsx* (accessed September 26. 2023).

wellbeing of people and country, it is necessary to look at the future of one's own country from the perspective of the countries with more advanced ageing and declining birthrates, and to develop appropriate policies in a timely manner using the future-back approach.

Figure 3 illustrates the trends of transition of older population and total fertility rate in Japan and Vietnam, two countries that have bilateral commitments (*20*) to

cooperate on ageing issues. In 1961, Japan established universal health insurance, and the percentage of older population at that time was 5.9% in Japan and 5.0% in Vietnam. It was not until 1997 that the older population in Vietnam reached the same level as Japan in 1961, and Vietnam took an additional 12 years to achieve the universal health insurance coverage in 2009. Next, Japan planned the introduction of long-term care insurance as a major next step to address the impending population ageing challenges. In the preparation stage, Japan started the Gold Plan in 1990 (older population: 12.4% in Japan, 5.6% in Vietnam) to systematically expand nursing homes and other facilities, and long-term care insurance was launched in 2000 (older population: 17.8% in Japan, 6.2% in Vietnam). Incidentally, Vietnam will, in 2030 and 2044, reach the same proportions of older population as Japan at the start the Gold Plan and launch of long-term care insurance, respectively.

As for the measures to combat declining birthrates in Japan, the act of childcare leave was enacted in 1991 (total fertility rate: 1.53 in Japan, 3.48 in Vietnam), and child allowance in 2009 (total fertility rate: 1.37 in Japan, 1.91 in Vietnam). However, it is not possible to estimate when childcare leave and child allowance would start in relation to total fertility rate in Vietnam, because the total fertility rate in Vietnam is estimated to remain constant at 1.94 after 2022. Knowing under what conditions policy development was made in countries with advanced fertility decline would make it possible to consider the policy in one's national context.

It is also important to recognize that even if effective policies are implemented, there is a time lag between the implementation of these policies and the observable effects. The regional difference in time lag between the occurrence of an event and the observable effects can be demonstrated by urban and rural districts in Japan. The Japanese living in Tokyo today have little opportunity to be aware of the reality that population in Japan is shrinking rapidly, because what they can see are downtown izakayas (Japanese-style pubs) overflowing with people including many youngsters, overcrowding commuter trains, and rising apartment rents due to the increasing demand. On the other hand, when one looks at the rural areas, the combination of an aged population with sharp decline in number of births, coupled with an exodus of young people to urban areas has made many rural communities of Japan unsustainable. When one visits even relatively large cities in rural Japan, one often witnesses many shuttered stores in the once thriving shopping arcades, closed banks and gas stations, and frequent suspension of public transportation services.

This is reality in Japan, but it could also be said that we are merely looking into the future of many Asian countries as Asia enters this period of population contraction in the mid-21st century and beyond. As sobering as this is, we must ask ourselves what public health can contribute. To cite a few examples, the first is to increase healthy and working life expectancy. This will prevent a sharp decline in the working-age population. Next, we could stimulate health investment in the smaller number of young people and raise a healthier next generation through a life course approach. Creating a medical and childcare environment in which people can give birth and raise children with a sense of security will also be necessary. Looking at countries that have succeeded in curbing the decline of fertility rate, participation by the health and welfare sectors alone is not enough, while truly coordinated multi-sectoral efforts are indispensable, such as improving the working environment and shifting the paradigm of parental roles. All these require a radical shift of the whole policy package, for which the "population strategy legislation" advocated by Yamazaki (*9*) in his novel could be an inspiration. Although the goal of healthy longevity is that all individuals in society live to the full extent of their ability, when social resources are depleted, some individuals tend to be left behind. This underscores the importance of ensuring that everyone has access to the resources and support necessary to thrive in a community. For this reason, I believe that more proactive measures to correct health disparities will be required more than ever before. In other words, "no one is left behind" is not just a slogan for low-income countries but a vital code of conduct for ourselves.

Conclusion

Population ageing and shrinkage overlap and significantly impact society at large through health issues. Still, the impact in countries, regions, and the world will become obvious with a time lag. Therefore, analyzing and critically reviewing the experience of Japan, a country already experiencing super-ageing and shrinking population issues, as well as Asia to which Japan belongs, and sharing the findings with the world will contribute greatly to those regions that will walk the same path in the future. In addition, Asia today and Africa from the mid-21st century are the regions where population growth continues. With a rapidly increasing productive population and active consumption, these regions are very important partners for international development of the medical industry to sustain the industry as a base for health security (*21*). Based on two excellent articles prepared by the staff members of WHO and UNFPA, I have attempted to add my opinion on the issues of population ageing and shrinkage, which tend to be considered in isolation. By reading the two articles together with my perspectives, I hope that the values of the articles will be further enhanced.

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References

1. United Nations. United Nations Decade of Healthy Ageing (2021-2030): resolution / adopted by the General Assembly. *https://digitallibrary.un.org/record/3895802?ln=en* (accessed May 12, 2023)
2. Government of Japan. Session Outcome: G20 Joint Session of Finance and Health Ministers. *https://www.mhlw.go.jp/seisakunitsuite/bunya/hokabunya/kokusai/g20/health/finance_and_health_ministers_session_outcome.html* (accessed May 12, 2023)
3. Kishida F: Human security and universal health coverage: Japan's vision for the G7 Hiroshima Summit. Lancet. 2023; 401: 246-247.
4. Ministry of Health, Labour and Welfare. G7 Health Ministers' Meeting in Nagasaki. *https://www.g7hiroshima.go.jp/ministerialmeetings/pdf/nagasaki_en.pdf* (accessed September 26, 2023)
5. Ministry of Foreign Affairs of Japan. G7 Nagasaki Health Ministers' Communiqué. *https://www.mhlw.go.jp/content/10500000/001096403.pdf* (accessed September 26, 2023)
6. Prime Minister's Office of Japan: Policy Speech by Prime Minister KISHIDA Fumio to the 211th Session of the Diet. *https://japan.kantei.go.jp/101_kishida/statement/202301/_00012.html* (accessed May 12, 2023)
7. Japan Times. Japan's birth rate continues to decline, plunging to new record low. *https://www.japantimes.co.jp/news/2023/02/28/national/japan-record-low-births/* (accessed May 12, 2023)
8. Ministry of Health, Labour and Welfare. Press Release Vital Statistics Report (December, 2022). *https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/geppo/s2022/dl/202212_1.pdf* (accessed May 12, 2023) (in Japanese)
9. Yamazaki S. Jinko Senryaku Houan, Jinko gensho wo tomeru housaku wa arunoka (Draft population strategy legislation: Any measures to prevent population decline?) ISBN-13:‎ 978-4532177102, Nihon Keizai Shinbun Publishing, Tokyo, 2021. (in Japanese)
10. Xu W, Lee S, Okayasu H. Promoting health ageing in the Western Pacific: A mini review of good practices and policy responses. Glob Health Med. 2023; DOI: 10.35772/ghm.2023.01005.
11. Boydell V, Mori R, Shahrook S, Gietel-Basten S. Low fertility and fertility policies in the Asia-Pacific region. Glob Health Med. 2023.
12. World Health Organization Regional Office for the Western Pacific. For the future: Towards the healthiest and safest region. *https://www.who.int/publications/i/item/for-the-future-towards-the-healthiest-and-safest-region* (accessed May 12, 2023)
13. World Health Organization Regional Office for the Western Pacific. Regional action plan on healthy ageing in the Western Pacific. *https://www.who.int/publications/i/item/9789290619352* (accessed May 12, 2023)
14. US National Academy of Medicine. The global roadmap for healthy longevity. *https://nap.nationalacademies.org/catalog/26144/global-roadmap-for-healthy-longevity* (accessed May 12, 2023)
15. United Nations Department of Economic and Social Affairs Population Division. World Population Prospects 2022. *https://population.un.org/wpp/* (accessed May 12, 2023)
16. Hara T. Sapience Gensho, Shukugen-suru Miraino Kadai wo Saguru (Decrease of Homo-Sapiens: Explore the Challenges of Shrinking Population in the Future). Iwanami Shinsho, ISBN-13:978-400431965 8, Iwanami Shoten, Tokyo, 2023. (in Japanese)
17. Nakatani H. Population aging in Japan: policy transformation, sustainable development goals, universal health coverage, and social determinates of health. Glob Health Med. 2019; 1:3-10.
18. World Health Organization. Decade of healthy ageing: Baseline report. *https://www.who.int/publications/i/item/9789240017900* (accessed May 12, 2023)
19. World Health Organization. Healthy ageing and functional ability. *https://www.who.int/news-room/questions-and-answers/item/healthy-ageing-and-functional-ability* (accessed May 12, 2023)
20. Office of Healthcare Policy, Cabinet Secretariat of Japan. Memorandum of cooperation between the office of healthcare policy, Cabinet Secretariat of Japan, The Ministry of Health, Labour and Welfare of Japan and The Ministry of Economy, Trade and Industry of Japan and The Ministry of Health of the Socialist Republic of Viet Nam in the fields of Healthcare. *https://www.kantei.go.jp/jp/singi/kenkouiryou/pdf/20190701_vietnam_hc.pdf* (accessed May 12, 2023). (in Japanese)
21. Nakatani H, Machida F, Honda Y, Kobayashi H, Kitano E, Inamura T, Kondo T. Approach of Medical Excellence JAPAN to create platforms of collaboration in Asia. Glob Health Med. 2021; 3:401-405.

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Promoting healthy ageing in the Western Pacific: A mini review of good practices and policy responses

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Abstract: The Western Pacific Region is experiencing rapid population ageing, which has implications for almost all areas of society. Countries will need to prepare for population ageing by investing in health and optimizing living environments. This requires a whole-of-society approach to healthy ageing. Countries in the Western Pacific Region have been making significant progress in healthy ageing. Since the endorsement of the Regional Action Plan on Healthy Ageing, younger societies have also started preparing for population ageing, focusing on social and health systems transformation, community-based integrated care, social and technological innovations and research, monitoring and evaluation. As more countries are interested in healthy ageing and preparing for necessary social and health systems transformation, the case studies in this article can be an inspiration for Member States to transform their approaches to achieving a society where older adults are healthier and can participate fully.

***Keywords*:** multisectoral collaboration, policy interventions, societal transformation, age-friendly environment, health system

Introduction

Population ageing is a demographic trend observed in many countries in the Western Pacific Region. Based on experiences from different countries, it often brings profound challenges and implications. In 2020, there were more than 245 million people aged 65 years and over living in the Region. This is expected to increase to around 458 million by 2040. Within two decades, the proportion of the region's population over 65 years will almost double from 12% to 23%. Population ageing impacts health systems and many other spheres of society, such as the labour market, education, housing, technology, transportation, and social protection. With the rising burden of non-communicable diseases (NCDs), most countries in the Region might face a financing gap in their health systems, based solely on projected changes in population structure and current financing sources (*1*). Countries also face challenges to address growing and diverse needs of ageing populations – older adults are a heterogenous group with a variety of preferences, needs and capacities (*2*).

Countries need to prepare for population ageing. Many countries in the Region, especially low- and middle-income countries, are experiencing rapid population ageing (Figure 1). It is estimated that Viet Nam will take 21 years to transition from an ageing society to an aged society and Brunei Darussalam will take 13 years for this transition. Countries experiencing rapid transition may have less time to form and implement adequate policy responses. Preparing for population ageing takes time and resources, but early investments can deliver high returns from a social and economic perspective. About one-third of economic growth in advanced economies could be attributed to improvements in population health in the past century (*3*). Every $1 invested in health is estimated to result in an economic return of $2 to $4 across developing countries (*4*). This will accelerate an inclusive and resilient COVID-19 pandemic recovery and sustainable development. Evidence also shows that promoting the employment of older workers and an age-friendly workplace is likely to have positive economic effects in the coming years, even among those countries with relatively young populations (*5*).

A complex interplay of multiple factors and conditions that affects health and well-being of ageing populations (*6,7*) should be addressed using a multisectoral approach. As identified in a systematic review, healthy ageing is affected by various determinants, including socio-demographic, biological, behavioural and psychological and social determinants (*8*). Social determinants shaping our opportunities to age in good health are largely outside the health sector. The major social factors affecting older persons' well-being are physical activity, diet, self-awareness, outlook/attitude, life-long learning,

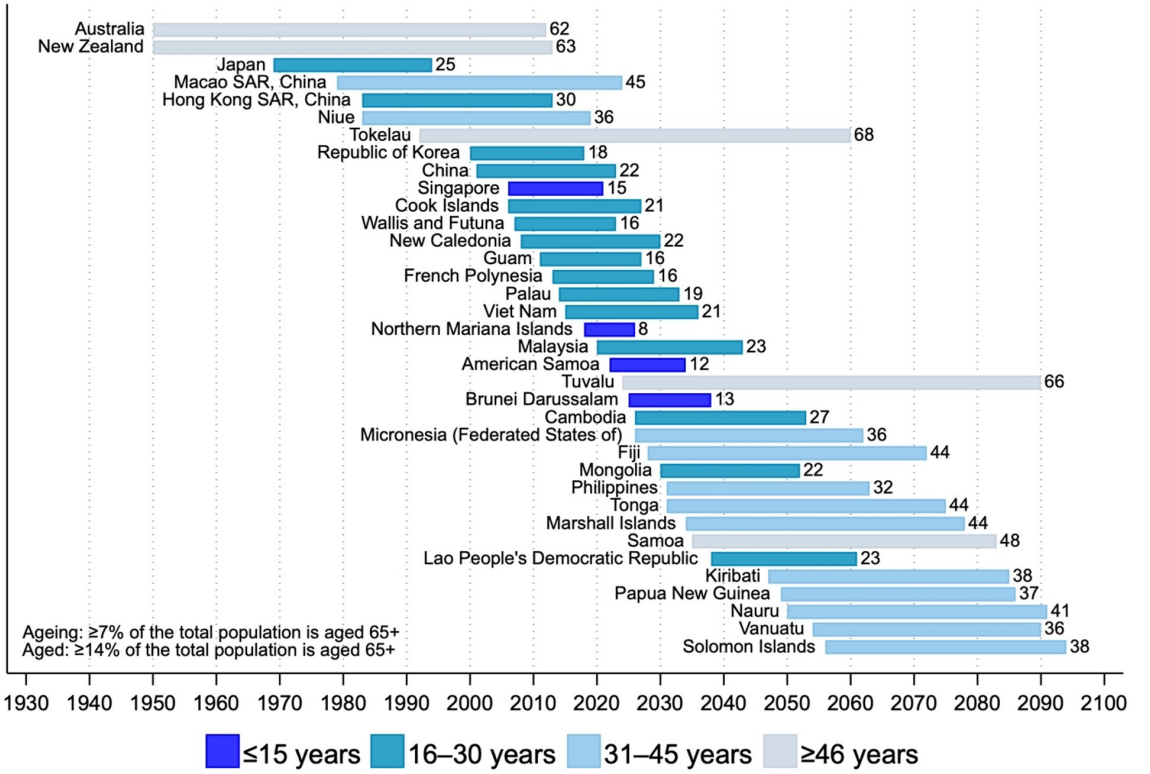

Figure 1. Speed of ageing in the Western Pacific Region (except for the Pitcairn Islands): Projected transition time from ageing to aged society. The projections displayed in Figure 1 are based on the United Nations' medium-fertility scenario, while the speed of ageing in Nauru, Palau and Kiribati is estimated by near-term information on population ageing. This article qualifies a country as "ageing society" if the proportion of people aged 65 years or more is between 7% and 14% of the total population. If the proportion surpasses 14%, it is an "aged society"; if over 21%, it is a "super-aged society". *Data source: United Nations Department of Economic and Social Affairs Population Division, World Population Prospects 2022.*

faith, social support, financial security, community engagement, and independence, as synthesised by a recent literature review (*9*). Many of the existing practices, aimed to enhance the above-mentioned factors, indicate that multisectoral collaboration and action can be effective in improving health and well-being in later life (*7,10*).

The World Health Organization (WHO) has developed the Regional Action Plan on Healthy Ageing in the Western Pacific to support countries with achieving a healthy ageing society. It was endorsed in 2020 by the WHO Regional Committee for the Western Pacific. It sets forth a long-term vision of healthy ageing in the Region, namely healthier older adults in the Western Pacific thriving and contributing to society. The Plan outlines five objectives to achieve this vision, including transforming societies as a whole, transforming health systems to address each individual's lifelong health needs, providing community-based integrated care, fostering technological and social innovation, and enhancing research, monitoring and evaluation. Member States have been working on the planning and implementation of customized healthy ageing policies and programs.

Given the emergent good practices and policy responses in the Western Pacific, the present article showcases good policy examples and interventions for healthy ageing and evaluations of progress in specified areas.

Case studies on healthy ageing in the Western Pacific

Transforming societies as a whole

Recognising that older adults' health is significantly determined by factors outside the health sector, countries in the Western Pacific have been developing age-friendly environments through cross-sectoral policy and program coordination.

China's national policy on creating an age-friendly society

In 2019, the Chinese government published the National Medium and Long-term Plan for Active Response to Population Ageing, which strengthens its vision, strategy, and institutional capacity of creating age-friendly environments. The objective of this Plan is to create an age-friendly society that promotes respect for older adults, implements the preferential treatment policy for older adults, safeguards the legitimate rights and interests of older adults, and gives full play to the positive role of

older adults. It aims to generally establish an age-friendly society by 2035, and generally establish age-friendly cities, villages and communities by 2050.

Korea's age-friendly programs that support the creation of new life models in later life

To support healthy ageing, the Korean government has been working to create an age-friendly environment and has made significant progress in areas like employment and social participation. Seoul 50 Plus Foundation of the Seoul Metropolitan Government has been building a workforce ecosystem for the 50+ aged group. The objective is to support people aged 50 or over to participate in social activities without discrimination and extend their work life so that they can enjoy independent and high-quality life in good physical, social and mental health as they age. Specifically, this Foundation supports this aged group to actively retain their social and economic activities by developing work models fit for people aged 50 and over, providing reemployment and career development opportunities through bridge jobs (*i.e.* 50+ internships), supporting people aged 50 or over to start a business, and providing social contribution activities. Additionally, Seoul has run an Ageing Policy Monitoring Group to increase opportunities for older adults to get involved in the making of policy decisions.

Philippines' establishment of a national coordinating body that promotes multisectoral collaboration in age-friendly communities

The Philippines, using a future-orientated way of thinking, has worked on creating healthier and safer environments for people of all ages, and on maximizing the contributions and capacities of older persons. In support of the Implementing Rules and Regulations of Republic Act No. 11350, the National Commission of Senior Citizens (NCSC) was established under the Office of the President in 2019 as a national coordinating body on ageing, to ensure the full implementation of laws, policies and government programs to protect older adults' welfare. The Commission closely working with the Department of Health and with support from WHO, has developed an initial draft of the 2023–2028 Philippine Plan of Action for Senior Citizens, through a consultative and participatory process. The plan adopts a whole-of-government approach to create age-friendly environments across relevant sectors. The Commission is now developing a national framework for age-friendly environments and implementing age-friendly programs in five local government units. Moreover, the Commission is promoting healthy and productive ageing through the Wellness, Health, Emergency Response and Benefits Division (WHEREBED), fostering intergenerational transformative dialogues and learning through the Senior Citizens' Action for Development and Nation-Building (SECADNA) project, and advocating that all seniors must have a minimum of an annual regular health, dental, optical, and aural examination (as a building block of a strong primary health care system).

Transforming health systems to address each individual's life-long health needs

Healthy ageing does not mean being disease-free. People may have one or more health conditions, when well controlled, have little influence on their well-being – everyone can experience healthy ageing (*7*). Healthy ageing requires taking a life-long approach to developing and maintaining functional ability to enable well-being in older age (*11*). As indicated by a framework for healthy ageing (Figure 2), health systems should address a

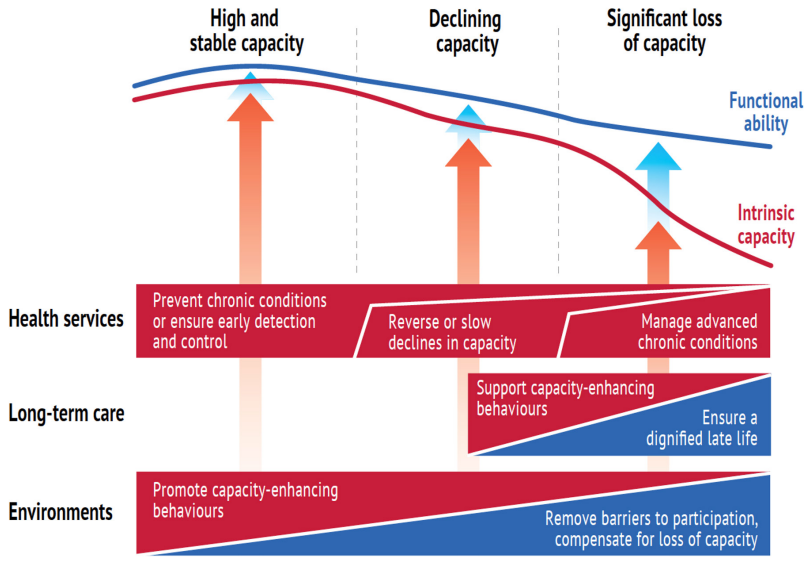

Figure 2. A public health framework for healthy ageing: opportunities for public health action across the life course. *Data source: World Health Organization. (2015). World Report on Ageing and Health.*

person's health needs throughout their lifetime, focusing on health promotion and disease prevention rather than the diagnosis and treatment of diseases.

Countries are encouraged to transform health systems to promote the functional capacity of individuals throughout their lives and create health-enabling environments. Prevention is strongly recommended, as lifestyle and behavioural factors play an important role in preventing disease, disability and death on an individual basis and on a larger scale in communities and populations (*7*). A person-centered approach inclusive of older adults should be adopted in health systems transformation (*12*). It applies to encouraging people to lead a healthier lifestyle, developing personalised care plans that address individual needs, and engaging communities in addressing the social and physical environment at an individual level.

Singapore's Healthier SG, a new strategy to transform the way we plan and deliver healthcare

In 2022, Singapore published its multi-year strategy centered on preventive care to improve the health of its population. Healthier SG will be launched in the second half of 2023. The strategy aims to prevent individuals from falling ill and empower individuals to improve their health, enabled by a strong doctor-patient relationship. The strategy helps transform "sick systems" – in which the health sector focuses on treating diseases – into "health systems" with health-enabling environments and systems that empower individuals to improve and manage their health proactively. The key features of Healthier SG are mobilizing the network of family doctors to deliver preventive care for residents, developing health plans that include lifestyle adjustments, regular health screening and appropriate vaccinations; activating community partners to support residents in leading healthier lifestyles; launching a national enrolment program for residents to commit to seeing one family doctor and adopt a health plan; setting up necessary enablers such as IT, manpower development plan and financing policy to make Healthier SG work (*13*).

Providing community-based integrated care for older adults

Communities can help reorient health and social services towards a more integrated and coordinated model of care to address the diverse needs of older persons. Communities are the meso-contexts of accustomed living environments that can affect older persons' health. Evidence shows that community-based intervention programs can help reduce the risk factors of functional decline and improve the health and well-being of older adults (*14*). Community-based integrated care is a promising approach to advancing service and support delivery for older adults and their families.

Japan's community-based integrated care system

Community-based integrated care is a system that coordinates the delivery of health-care services, long-term care services as well as social activities, and services to older adults based on their individual needs and preferences (*6*). Japan has been developing this system since 2006 as a part of the reformed Long-term Care Insurance Law, to support older adults to continue living in areas where they are used to living. To implement this system, Japan has established 24-hour routine home-visit services and needs-based care services, fostered collaboration between medical care and long-term care, improved coordination between a wide range of care providers, and increased integration at different levels (system, organizational, clinical) (*15*). A variety of stakeholders are involved including older adult users, caregivers, community residents, health and social care providers, non-profit organisations, community associations, municipalities and the state.

Cambodia's national ageing policy and training program on integrated care for older people

The Cambodian government has been operationalising the National Ageing Policy (2017–2030) and enhancing institutional capacity for the care of older people. These efforts include fostering Integrated Care for Older People (ICOPE), which can help identify risk factors for preventing and managing NCD symptoms early, following onset, to maintain the functional ability of older adults for as much as and as long as possible (*16*). Recognising the importance of a person-centred and community-based approach to care, Cambodia is developing a national training curriculum for primary healthcare services, and a training program for healthcare workers, which are tailored to local context and needs. Such capacity-building efforts are enabling more inclusive, age-friendly care pathways.

Fostering technological and social innovation for healthy ageing

Technological innovations can facilitate healthy ageing in various ways. However, older adults are often left behind in the rapid digital transformation, which has prevented them from opportunities for better health and well-being. As internet access is emerging as a social determinant of health (*17*), it has become ever more important to close the digital divide. Various types of digital technology could be leveraged to deliver personalised care to address the diverse needs of ageing populations (*18*). Digital innovations to improve older adults' lives and efforts to close the digital divide should be amplified. New digital solutions to enable a person's

increased control over their health, and innovations to maintain and promote the functional capacity of individuals should be accessible and available to older persons of different backgrounds (*19*).

BruHealth, a mobile health application going beyond COVID-19 control in Brunei Darussalam

BruHealth was developed by the Government of Brunei Darussalam and initially used as a contact tracing app that has expanded into a growing multi-sided e-health platform. The application provides residents updates on COVID-19 transmission and related policy measures, monitors the health conditions of patients through the self-assessment feature and tracks risk exposure of residents using the Bluetooth and GPS tracking features. BruHealth uses algorithms to determine the individual personal health status with the use of questionnaires related to their health status. The key features of this mobile application include personalized health planning, user empowerment, shared decision-making, supporting health behaviour change and integration with the government's health information and management system, namely Bru-HIMS. As we return to normal, the BruHealth App is now in progression towards the digital healthcare engagement journey with the Bruneians. Health score of an individual including disease specific digital therapeutics interventions and care plans will also be available for Bruneians to take ownership of their health. This is an important milestone for Bruneian's Healthcare as the planned digital interventions will address all segments of the population.

China's new national plan on smart eldercare

In 2021, China's Ministry of Industry and Information Technology, the Ministry of Civil Affairs, and the National Health Commission jointly issued the Action Plan for the Development of Smart Health and Eldercare Industry 2021–2025, which is the comprehensive and specialized national policy on smart eldercare and has a clear development direction by 2025. The action plan outlines a series of measures to develop smart eldercare, such as developing new technologies and digital products, expanding smart health services and smart elder care scenarios, increasing capacities of health management and data application, promoting age-friendly technology, improving digital literacy of older adults, optimising industrial environments and enhancing digital public services.

Social innovations for healthy ageing offer novel solutions to address complex issues of ageing and represent key drivers for generating positive changes to living environments. Such solutions include identifying new ways of addressing social determinants of health, developing cost-effective interventions to enhance the functional ability of older adults, redesigning spaces for age-friendly environments and fostering social entrepreneurship opportunities.

China's social prescribing program

Social prescribing is a means for healthcare workers to connect people to a range of non-clinical services in the community, to improve health and well-being. It can help to address the underlying causes of health issues, such as anxiety, loneliness, depression and non-communicable diseases (*20*). Shangrao city in China conducted a social prescribing program in early 2021, as part of the city's strong commitment to improving the mental health care of older adults. The program involves healthcare providers, social and voluntary sector organisations, and link workers (mostly community health workers and volunteers). It is currently being introduced to more communities in various forms that all connect people to a range of non-clinical services in the community. The initiatives are often based on discrete funding sources and small-scale localized programs (*21*).

Viet Nam's intergenerational self-help clubs

The intergenerational self-help clubs (ISHCs) in Viet Nam are community-based voluntary organizations that promote the well-being of individuals and support community development. ISHCs conduct income-generating, social, cultural and health-promoting activities with older residents and promote international cross-learning and sharing on various topics, with the support of local governments. Each ISHC is composed of 50–70 community members, most of whom are older adults disadvantaged in society. ISHC is an inclusive and cost-effective intervention, given that the clubs are built upon financial, human, technical and other social resources, including older adults. The expansion of the ISHC model was included as a national government target in the 2012–2020 National Plan of Action on Ageing and in the 2016 Prime Minister Decision 1533. By the end of 2019, 2,985 ISHCs have been established covering 60 out of the 63 provinces as more requests to help set up ISHCs continue to be received from throughout Vietnam (*22*). Viet Nam set up a target of reaching 6,500 clubs nationwide by 2025 and improving integration with health services.

Strengthening research, monitoring, and evaluation

Generating and applying knowledge not only tackles the challenges of ageing societies but also allows us to imagine, create, and sustain new visions for aged societies. Researchers are encouraged to conduct research on building an investment case for policy change, identifying win-win opportunities for aligning

health goals with those of other sectors, developing integrated care models for older adults, and evaluating innovative approaches to healthy ageing.

Monitoring the progress on healthy ageing can deepen our understanding of the changes associated with ageing and provide opportunities to evaluate the impact of policy reforms and interventions. Many countries in the Region have weak data systems on the health status and needs of older adults, which can prevent further development of programs, services and policies for older adults. Longitudinal data on older adults is available in countries like Australia, China, Japan, Malaysia, New Zealand, the Philippines, the Republic of Korea, Singapore and Viet Nam. Thus, accelerated efforts are demanded to collect age-, gender- and spatially disaggregated data on older adults in terms of health, socioeconomic status, and the contributions that older adults make to society (*6*).

Palau's research on ageing for evidence-informed national policy and interventions

There has been a lack of data and evidence generated on older persons in the Pacific Island context, which prevents an accurate picture of older adults' lives and their living environments and often leads to fewer evidence-informed policies and interventions. Palau is conducting research to assess the circumstances, experiences, needs and expectations of older adults, their families and communities, which will help gather knowledge about lived experiences and circumstances of older adults. In addition to the research, Palau conducted consultations with older adults and other stakeholders such as policymakers, non-profit organizations, social and healthcare workers, and community leaders to identify existing resources and actions needed to promote healthy ageing. Such endeavours will support policy development on ageing that suits national and subnational contexts.

Vanuatu's situational analysis of healthy ageing for advocacy and partnership

There is currently limited discussion of the experiences of older adults in Vanuatu and the policy context impacting their daily lives. To address this limitation, Vanuatu is conducting a situational analysis of older adults' health and social circumstances. Informed by the best available evidence, Vanuatu conducted an advocacy initiative and policy consultations that contributed to capacity building for policy development and cross-sectoral collaboration on healthy ageing.

Conclusion

Social and health systems transformation for healthy ageing requires a long-term vision and commitment. Nevertheless, investing early can yield significant returns for individuals and society as a whole. Countries could find inspiration from innovative best practices for healthy ageing from other countries and customize approaches for healthy ageing based on their context. Younger societies can learn from the experience of aged and super-aged societies in transforming social and health systems; aged and super-aged societies can also be inspired by new innovative practices and approaches at work in younger societies. Knowledge exchange will continue to be key in creating a healthy ageing society for the Western Pacific Region.

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References

1. European Observatory on Health Systems and Policies, Normand C, Williams G, Cylus J. The implications of population ageing for health financing in the Western Pacific Region: Exploring future scenarios and policy options for selected countries using the PASH simulator. *https://apps.who.int/iris/handle/10665/364195* (Accessed January 10, 2023).
2. Abdi S, Spann A, Borilovic J, de Witte L, Hawley M. Understanding the care and support needs of older people: A scoping review and categorisation using the WHO international classification of functioning, disability and health framework (ICF). BMC Geriatr. 2019; 19:195.
3. Arora S. Health, human productivity, and long-term economic growth. J Econ Hist. 2001; 61:699-749.
4. Remes J, Linzer K, Singhal S, Dewhurst M, Dash P, Woetzel J, Smit S, Evers M, Wilson M, Rutter KA, Ramdorai A. Prioritizing health: A prescription for prosperity. *https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/prioritizing-health-a-prescription-for-prosperity* (Accessed January 10, 2023).
5. Cylus J, Al Tayara L. Health, an ageing labour force, and the economy: Does health moderate the relationship between population age-structure and economic growth?

Soc Sci Med. 2021; 287:114353.
6. World Health Organization Regional Office for the Western Pacific. Regional action plan on healthy ageing in the Western Pacific. *https://www.who.int/publications/i/item/9789290619352* (Accessed January 10, 2023).
7. World Health Organization. Decade of healthy ageing: Baseline report. *https://www.who.int/publications/i/item/9789240017900* (Accessed January 10, 2023).
8. Kralj C, Daskalopoulou C, Prince M, Prina M. A systematic review of the determinants of healthy ageing. Innov Aging. 2017; 1(Suppl 1):1315-1315.
9. Abud T, Kounidas G, Martin KR, Werth M, Cooper K, Myint PK. Determinants of healthy ageing: A systematic review of contemporary literature. Aging Clin Exp Res. 2022; 34:1215-1223.
10. US National Academy of Medicine. The global roadmap for healthy longevity. *https://nam.edu/initiatives/grand-challenge-healthy-longevity/global-roadmap-for-healthy-longevity/* (Accessed January 10, 2023).
11. World Health Organization. Healthy ageing and functional ability. *https://www.who.int/news-room/questions-and-answers/item/healthy-ageing-and-functional-ability* (Accessed January 10, 2023).
12. World Health Organization Regional Office for the Western Pacific. For the future: Towards the healthiest and safest region. *https://www.who.int/publications/i/item/for-the-future-towards-the-healthiest-and-safest-region* (Accessed January 10, 2023).
13. Ministry of Health of Singapore. The White Paper on Healthier SG. *https://www.healthiersg.gov.sg/resources/white-paper/* (Accessed January 10, 2023).
14. Seah B, Kowitlawakul Y, Jiang Y, Ang E, Chokkanathan S, Wang W. A review on healthy ageing interventions addressing physical, mental and social health of independent community-dwelling older adults. Geriatr Nurs. 2019; 40:37-50.
15. Tsutsui T. Implementation process and challenges for the community-based integrated care system in Japan. Int J Integr Care. 2014; 14:e002.
16. World Health Organization. Integrated care for older people: Guidelines on community-level interventions to manage declines in intrinsic capacity. *https://apps.who.int/iris/handle/10665/258981* (Accessed January 10, 2023).
17. Ota A, Shobugawa Y, Cable N, Tajika A, Nakagomi A, Chishima I, Ide K, Ueno T, Fujihara S, Fujinami Y, Yasufuku Y, and Ando Y. Understanding the role of internet access on health and health equity toward healthy ageing in the Western Pacific Region. Kondo N, Koga C, Nagamine Y, editors. Tokyo: Japan Gerontological Evaluation Study; 2021.
18. Mbunge E, Muchemwa B, Jiyane S, Batani J. Sensors and healthcare 5.0: Transformative shift in virtual care through emerging digital health technologies. Global Health Journal 2021; 5:169-177.
19. Marston HR, Musselwhite CBA. Improving older people's lives through digital technology and practices. Gerontol Geriatr Med. 2021; 7:23337214211036255.
20. Dingle GA, Sharman LS. Social prescribing: A review of the literature. In: Existential Concerns and Cognitive-Behavioral Procedures. Cham: Springer International Publishing; 2022. p.135-149.
21. World Health Organization Regional Office for the Western Pacific. A toolkit on how to implement social prescribing. *https://www.who.int/publications/i/item/9789290619765* (Accessed January 10, 2023).
22. HelpAge International in Vietnam. The Intergenerational Self-Help Club (ISHC) development model. *https://www.ahwin.org/helpage-vietnam-ishc/* (Accessed January 10, 2023).

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Low fertility and fertility policies in the Asia-Pacific region

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Abstract: Declining fertility is an increasing global trend. In many low fertility contexts, people are having fewer children then they want, and these unfulfilled fertility desires have been associated with wider socio-economic changes in education and labour force participation and conflicting and often contradictory expectations of women at home and at work. The right to determine if, when and how one has children is enshrined in international law yet many policies responses to low fertility fail to meet these standards. This paper summarizes why people in the Asia-Pacific region are having fewer children than they desire, and the range of policy responses, particularly those that make life easier for working parents. This raises two important points. First, we need to contend to the gender dynamics that underpin this in the region, despite gradual changes in women's roles, they are still seen as "caregivers" and undertake a disproportionate amount of unpaid care work, often having to lean-out of their employment, and/or face gender discrimination in the workplace. Second, the "emergency" of low fertility arises from complex social and economic conditions that cannot be solved by population policies solely focused on making babies.

***Keywords*:** low fertility, mini-review, reproductive rights, determinants, policies, Asia-Pacific

Introduction

Low and ultra-low fertility – that is, a total fertility rate (TFR) at or below the replacement level of 2.1 live births per woman – is an increasing global trend in 83 of 201 countries. By 2050, the average global fertility rate is predicted to decline to 2.1 (*1*). Some countries in Asia and Europe have reached "ultra-low" fertility rates, with a period TFR at 1–1.4 and family size at 1.4–1.6 births per woman born in mid-1970s. In many low fertility contexts, people are having fewer children than they want (*2*). Figure 1 describes declining fertility rates in the Asia-Pacific region compared to selected other countries. These unfulfilled fertility desires have been associated with wider socio-economic changes in education and labour force participation and conflicting and often contradictory expectations of women at home and at work (*3-6*). Such challenges to fulfilling fertility desires run counter to people's right to decide if, how and when to have children.

In some contexts, low fertility is seen as a threat and engenders anxieties about a shrinking workforce; reduced productivity; and ethnic, religious, and national decline (*7,8*). In response, governments have put in place explicit or implicit pronatalist policies, ranging from family-friendly workplaces through limiting access to contraception and abortion care. According to the World Population Policy database, the percent of countries with pronatalist policies has risen from 19% in 1976 to 28% by 2015 (*9*). Many governments are searching for the right blend of policy interventions that are effective at the population level and are socially acceptable for individuals. According to international law, such policies should support self-determination, so the number of children a person has corresponds with the number of children they desire.

However, in some contexts policy response to declining fertility may be at odds with self-determination, insofar as they exacerbate unmet need and/or are otherwise experienced as coercive. In 2021 and 2022, the Chinese government put in place two proposals to decrease women's access to safe abortion after decades of access (*10*). In Iran, the 2021 "Rejuvenation of the Population and Support of the Family" Bill limits access to abortion, free contraception, and sterilization (*11*). In 2020, the government in Viet Nam, introduced the "birth rate adjustment programme" to increase the birth rate by 10% in places with below replacement rates and reduce the fertility rate in places with a higher birth rate (*12*). The emergence of these policies compels us to both review the determinants and policy responses to low fertility and ensure the policies options suggested

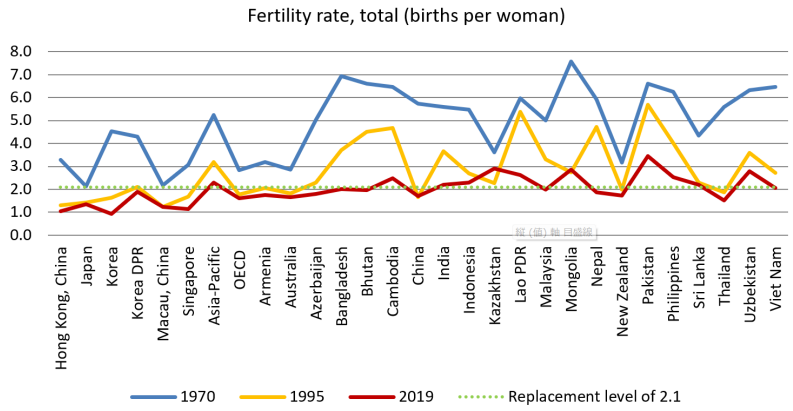

Figure 1. Fertility rates in Asia-Pacific compared to selected other countries. Fertility rates for selected countries globally are presented by years 1970, 1995 and 2019 using blue, yellow and maroon color lines, respectively. Replacement fertility level is indicated by green dashed line.

are grounded in human rights and self-determination. As declining fertility becomes a common demographic trend, there is mounting literature that attempts to understand its causes and the associated policy responses. This paper provides a mini review of the key debates in the Asia-Pacific context.

The internationally agreed principles underpinning fertility desires

National and global policy responses to low fertility are shaped by the same principles as high fertility. The right to determine if, when and how one has children is enshrined in the Programme of Action arising from the 1994 International Conference on Population and Development (ICPD) and UN CESR (2000) General Comment 14 (*13,14*). The Programme of Action, adopted by 179 countries, outlines a clear vision in which all individuals can freely decide the number and spacing of their children: "*All couples and individuals have the basic right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to do so*" (ICPD Programme of Action, 1994). The principles are grounded in international human rights law and are universal – in that they apply to all individuals regardless of high and low fertility. Reproductive health services should support individuals to postpone and stop having children, as well as to have and care for the children they want.

Determinants of low fertility in the Asia-Pacific region

Mounting evidence points to the interrelated factors that prevent people from fulfilling their fertility desires. First, the traditional norms and societal expectations in the region place a disproportionate burden on working women to balance family and professional life that work against them from achieving their desired fertility. Related to this, is the continuing gender disparity in unpaid care work. These factors are further compounded by changes in parenting with more time, money and effort expected to raise a child. The increased cost of housing, financial and economic precarity and social upheaval further contribute to people postponing having children and starting families. We briefly consider each of these dynamics in the Asia-Pacific context.

Women's increased participation in the formal labour force, encouraged by changing gender norms and laws, changing patterns of consumption and status requirements, and in some cases, the economic imperative for dual-income households has created conflicting demands on women. With women spending longer time in formal education and their career trajectories demanding long working hours, inflexible work situations, and limited support during and after pregnancy (such as the lack of parental leave and childcare), many women may choose to postpone or not marry and delay childbearing. In many East Asian contexts marriage and childbirth are proximally linked with low fertility because of the social expectation that marriage is a precondition for childbearing (*15-18*). In many East Asian contexts, there is also an expectation of long and inflexible working hours in person required for promotion, benefits and seniority and employees are little appreciated for their commitment to family responsibilities and long commuting time (*19-22*).

Yet despite women's increasing participation in the workforce, they are still expected to take on the majority of the unpaid childrearing, care of family members, and housework (*17*), resulting in a gender-skew in unpaid work. Women devote more time to unpaid care and domestic work – a time-use study found that, on average, women spent 314 minutes compared to the 190 minutes per day men spend on unpaid care and domestic work (*23*). This did not vary depending on a woman's educational and marital status, and has not changed over time. This is more pronounced in countries with traditional gender arrangements. According to UN Women (2016) in Viet Nam, the term "unpaid care and domestic work" is not officially used but is referred to as "housework" (viec nha) or "family work" (cong viec Gia dinh), which are considered as primarily women's responsibilities. This makes unpaid care and domestic work invisible and underestimates its economic value in public policies (*24*). With 88% of household work

performed by women, Japan and Republic of Korea appeared (around 2010) to have the most unequal gender division of domestic work among the Organization for Economic Development and Cooperation countries (*25*).

The absence of quality childcare services, especially for children under three-years-old, affects people's childbearing choices (*20-26*). Until recently, the cost of raising children in China, particularly affordable childcare, was high. Most childcare provision is funded out of pocket by parents and presents a significant financial burden, which affects the poorest families most (*27*).

The conflicting expectations of women at work and at home is exacerbated by the concurrent trend of intensive parenting. Norms around parenting have shifted and there are increased expectations about parental engagement. Because of the immense value given to education in the region, households are spending more of their income and time in educating their children to prepare them to be competitive in today's labour market. In China, parents' invest in cram classes, extracurricular activities and spend a lot of time on homework as well as being in regular communication with their children's teachers, although the government has recently begun to regulate private tutoring (*28*). In this "educational arms race", parents may decide to limit the number of children they have to invest heavily in one child rather than spread their resources across two (*29*). This has greater impact on mothers, since they are expected to take primary responsibility for childcare, but also for that generation of mothers who were only children and whose parents heavily invested in their own education (*30*). The high costs of raising children, such as childcare, food, education, housing and other expenditures, also act to deter people from having children (*20,31-33*).

Intensive parenting can increase economic pressure on families, and there is a desire to be closer to high-quality schools, which pushes up housing prices in those areas. The increasing cost of living, particularly around housing, is a symptom of deepening economic inequality, and this means that families may delay having children because they are unable to purchase a home. Several studies have found a negative relationship between housing and fertility (*34-36*). In Singapore, with one of the lowest replacement rates globally, increases in housing prices were associated with a reduction in total fertility rate (*36*). The expensive real estate market in Hong Kong SAR prices young people out of housing and consequently, 53% single, middle class 30–40 years old planned to delay marriages in order to save for housing (*26*). Similarly, the expensive property rental market in the Republic of Korea can also delay marriage for young single adults (*26,37,38*).

Finally, economic and labour market uncertainty, can depress and postpone fertility. In Iran panel data from 1966 to 2013 found that the unemployment rate was negatively associated with fertility (*39*). In fact, the high unemployment rate seemed to negate the cash incentives that were used to encourage people to have children (*39*). Studies in Iran indicate that potential costs of having a family is a significant deterrent for people from having the children they desire (*40,41*). The 1997 economic crisis created a dramatic surge in unstable working conditions in Japan and in Republic of Korea (*37,42*). In the decade after the crisis, substantial labor market inflexibility was faced by new mothers returning to jobs and they often had to take lower rank jobs (*43*).

Gender inequalities at home and in the workplace cut across the various drivers associated with low fertility, from the distribution of unpaid labour and to the limited care options for families that makes balancing work and family life complicated, particularly for women. All of the factors are further exacerbated by societal upheaval and crisis, such as war, pandemic, and economic disruption, which can create social, political and economic changes that discourage childrearing and family formation (*44*).

Policies responding to declining fertility in the Asia-Pacific region

As fertility continues to decline in the Asia-Pacific region, there has been a wide range of policy responses. Polices aimed at boosting fertility rates range from broader financial support to families, to policies that attempt to reconcile work and family life as well as policies that seek to increase the birth rate by reducing access to contraceptive and abortion care. Such policies adopted are often shaped by the orientation of a particular government (*45,46*).

Several recent reviews of policies responding to low fertility have found that policy instruments that aim to improve family life (*e.g.* paid leave, childcare services, and flexible working hours) had positive influences on fertility (*2,47*). Overall, there is a positive correlation between government spending on families and all fertility indicators (*2,48,49*).

Policies that make working parents' lives better appear to have a lasting impact on fertility. Expanding the availability and accessibility of high-quality public childcare influences not only fertility timing, but also completed family size (*2,46,47*). High quality childcare that is trusted by parents, available for children of all ages, aligns with parent's working schedule and does not incur high costs are optimal. The most recent Five-Year Plan in China is attempting to increase childcare services from 1.8 per 1,000 people in 2020 to 4.5 in 2025. Longer parental leave and flexible working have also been found to have a modest influence on fertility (*2,46,47*) For example, longer paid parental leave for early years was found to increase fertility in Europe (*46*). Also flexibility in working life such as the opportunities and support for employment after a career break, adjustable working

hours, part-time work, that allow people to combine employment with family life were associated with increases in fertility.

However, financial incentives and one-off cash transfer (*e.g.* baby bonuses) were found to have a short-term impact as compared to policies that support parents to work because they only cover a small proportion of the overall costs of raising children and may influence the timing but not the completed family size (*2,46*). Though these reviews are sensitive to the relative role of income and education level, further disaggregated analyses could help us to better understand how policies interact with marital status, age, employment status, sexual orientation and religion, for instance (*46*).

Japan implemented a series of policies and institutional reform extensions to create favorable environments for work and family life balance (WLB) targeting women and children by including: improved accredited childcare services, incentives for men to be more involved in childcare, more flexible work for employees with children and better housing, education and healthcare facilities for families with children (*50*). Since 1992 Japan's parental leave policy offers 12 months without compensating income (this is extended to 14 months since 2010 if couples participate) and since 1995 this has included paid leave with several amendments. Currently the benefits include increasing financial compensation and further leave flexibility *e.g.*, during leave parents can receive 50% of monthly salary benefit prior to the leave (*42,51*).

Yet, the Japanese policies seem to be largely ineffective in addressing low fertility as the period TFR remains at a low of 1.43% (2018), though recovered from a record low of 1.26%, and the completed cohort fertility has stopped declining and childlessness (at 28%) has largely stabilized (*2*). Despite the Republic of Korea's attempts to address ultra-low fertility through policy initiatives such as expanded childcare programs and reducing extensive working hours had no effect on the TFR, which is the lowest globally recorded TFR of 0.98 in 2018 (*32,52,53*).

These policies that attempt to reverse fertility declines are not necessarily effective at achieving their aim. Policies can be incoherent and counteract each other; they can be too short lived; they can be ineffective at fostering behaviour change because they do not address the factors influencing fertility choices or because they do not respond to needs of a diverse range of parents: single parents, unmarried, same sex families to name a few. In the Republic of Korea, there were a series of ambitious family reform policies to address the ultra-low fertility including longer paid parental leave, efforts to reduce long working hours, and expanded childcare provisions (*52,53*). Yet this scheme (and other provisions) was only aimed at employed women who had national employment insurance and, as a result, excluded over a third of working women (*52*).

Discussion

Trends in gender equality

In the last half a century there have been dramatic changes in gender equality in which women's participation in higher education and employment have increased considerably and women have entered fields traditionally dominated by men (*54*). Concurrently social expectation of the role of men and women have changed. Though there has been progress in gender equality, there are significant areas where this "gender revolution" has slowed or stalled (*55*). One example of this is the different legal treatment of working women. Women can still be dismissed for getting pregnant in Malaysia, Myanmar and Singapore to name a few (*56*). Only a handful of governments in the region cover 100% of maternity benefits, and when these costs are born by employers it acts as a disincentive to employ women of reproductive age (*56*). While laws and regulations promoting gender equality have been made, the International Labour Organization (2018) found that change has been slow due to social attitudes, unconscious biases, limited capacities and limited accountability systems. Women continue to face obstacles related to limited choice of work, poor working conditions, inadequate employment security, wage inequality, and occupational segregation (*57*).

In the "gender revolution", women's entry into the workforce came more readily than changes in men and women's roles at home in relation to childcare and housework (*55*). As seen with COVID-19, there continues to be implicit pressure on women to do more unpaid work for the family than for men (*54*). Though societal attitudes about women in education and in the workplace may have changed, women are still regarded as the caregivers and therefore undertake a disproportionate amount of unpaid care work, often lean out of their employment, and face gender discrimination in the workplace. Also, women's limited decision-making after marriage may prohibit them from exercising their rights in pregnancy, childrearing, and work (*58-60*).

In the Asia and the Pacific region, women work the longest hours in the world, with over half their time dedicated to unpaid care work (*61*). These high levels of unpaid work influences how women allocate their time and jobs they do. Due to women's multiple responsibilities, women often seek paid work that is flexible, yet this means it is often lower-paid and insecure jobs or working in the informal sector (*61*). According to the ILO (2018), 64 % of the women employed in the region are in informal employment. These gendered labour market dynamics curtail the potential reach of many promising policies as they are limited to women in formal employment.

Need for better problem definition

We should also pause to consider the goals of these policies. Why are policymakers across the region trying to increase fertility rates? Clearly, the prevailing demographic narrative in the region is a general concern about the population ageing, stagnation and, ultimately, decline. These are, of course, brought about primarily through low fertility (as well as improvements in mortality and out-migration). In this sense, then, it is apparent that many policymakers (and commentators) seek a simple response – a demographic solution (raising fertility) to a demographic problem. As such, the goals of many family policies which have an explicitly (or implicitly) pronatalist component is to raise the fertility rate.

This approach is problematic for several reasons. First, of course, such a target-driven approach as a motivation for population/family policy goes against the guiding principles of the ICPD. Population policies should be about enabling people to meet their reproductive aspirations, rather than built around instrumentalizing women's wombs as a means of "growing the country" or rendering public finances more sustainable.

Second, it is difficult to envisage the extent to which such policies can ever be successful in their stated aims. We have already seen that fertility rates have been stubbornly low, even in settings where tremendous investment has been put into family policy (*e.g.* the Republic of Korea). This tells us that cultural norms must be dealt with rather than financial investment. However, more broadly, any babies born as a result of pronatalist policies will not enter the labor force for at least another twenty years. By this time, the nature of the labor market will have probably changed beyond recognition and, without internal reform, the stresses on pension and social welfare systems will likely already be beyond redemption.

Together, we can argue that the reason for this mismatch is the poor problem definition regarding the real challenges of the prevailing, and developing, population paradigm in the region. Greater sustainability in pension systems, for example, is better achieved through paradigmatic and parametric reform rather than "having more babies". Reducing the so-called "burden" of ageing will better come about from increasing productivity; improving active ageing and health across the life course; poverty reduction and increasing gender equality. Population decline at the regional level needs to be addressed by looking more clearly at why people are leaving, and addressing issues such as infrastructure, public services and cultural heritage. These are complex issues, which require holistic responses targeting interlinked factors at the multilevel.

Conclusion

Looking for simple solutions – more babies - and the basing of such policies in shaky science, sexism, xenophobia, and regressive gender values, has led to the development of new approaches which have no place in contemporary population policy. Rather, we should be true to the ICPD principles of emphasizing the need to support individuals to build their families in their own way and their own time, while developing population policies to tackle the prevailing challenges, which are complementary to that approach. These policies can include ensuring that full potential is realized for everyone.

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References

1. United Nations Department of Economic Social Affairs (UNDESA). World population prospects 2022: Summary of results. UNDESA/ POP/2022/TR/no.3. New York, United Nations, 2022.
2. Sobotka T, Matysiak A, Brzozowska Z. Policy responses to low fertility: How effective are they? Working Paper No. 1. 2019. *https://www.unfpa.org/sites/default/files/pub-pdf/Policy_responses_low_fertility_UNFPA_WP_Final_corrections_7Feb2020_CLEAN.pdf* (accessed September 28, 2023).
3. Comolli CL. The fertility response to the Great Recession in Europe and the United States: Structural economic conditions and perceived economic uncertainty. Demogr Res. 2017; 36:1549-1600.
4. Myrskylä M, Goldstein JR, Cheng, YA. New cohort fertility forecasts for the developed world: Rises, falls, and reversals. Population and Development Review. 2013. 39:31-56.
5. Goldstein HR, Kreyenfeld M, Jasilioniene A, Örsal DK. Fertility reactions to the "Great Recession" in Europe: Recent evidence from order-specific data. Demogr Res. 2013; 29:85-104.
6. Wilkins E. Low fertility: A review of the determinants. Working Paper No. 2. 2019. *https://www.unfpa.org/publications/low-fertility-review-determinants* (accessed September 28, 2023).
7. Whittaker A. Demodystopias: Narratives of ultra-low fertility in Asia. Econ Soc. 2022; 51:116-137.
8. Longman P. Think again: Global aging. Foreign Policy.2010; 182:52-58.
9. United Nations. World population policies database. 2022. *https://www.un.org/development/desa/pd/data/world-population-policies#:~:text=The%20World%20*

Population%20Policies%20Database,national%20population%20policies%20and%20programmes (accessed September 28, 2023).
10. NHC-China. Guiding opinions on further improving and implementing active reproductive support measures. 2022. *http://www.nhc.gov.cn/rkjcyjtfzs/s7785/202208/9247dd64744c42df9522c4fa2cb78e42.shtml* (accessed September 28, 2023). (in Chinese)
11. Berger M. Iran doubles down on abortion and contraception restrictions. Washington Post. 2021. *https://www.washingtonpost.com/world/2021/12/01/iran-doubles-down-abortion-contraception-restrictions/* (accessed September 28, 2023).
12. Việt Nam News. More than 20 localities have low birth rate: MoH. 2020. *https://vietnamnews.vn/society/738257/more-than-20-localities-have-low-birth-rate-moh.html* (accessed September 28, 2023).
13. United Nations. Report of the international conference on population and development. *https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/a_conf.171_13_rev.1.pdf* (accessed September 28, 2023).
14. UN (United Nations) Committee on Economic, Social and Cultural Rights (CESR) (2000). Substantive issues arising in the implementation of the international covenant on economic, social and cultural rights. *https://digitallibrary.un.org/record/425041?ln=en* (accessed September 28, 2023).
15. Irene B. Taeuber. The population of Japan. Science. 1959; 129:1131.
16. Tsuya N, Choe M. Changes in intrafamilial relationships and the roles of women in Japan and Korea. NUPRI Research Paper Series 58, Tokyo, Japan, 1991.
17. Bumpass LL, Rindfuss RR, Choe MK, Tsuya NO. The institutional context of low fertility: The case of Japan. Asian Popul Stud. 2009; 5:215-235.
18. Frejka T, Jones GW, Sardon JP. East Asian childbearing patterns and policy developments. Popul Dev Rev. 2010; 36:57-606.
19. Brinton MC. Sharing burdens a remedy for falling birthrates. East Asia Forum Quarterly. 2019; 11:3-5. *https://press-files.anu.edu.au/downloads/press/n5214/pdf/book.pdf* (accessed September 28, 2023)
20. Rindfuss RR, Choe MK. Low and lower fertility. Variations across developed countries. Springer International Publishing, 2015.
21. Nobuko N, Brinton MC. The gender division of labor and second births: Labor market institutions and fertility in Japan. Demogr Res. 2017; 36:339-370.
22. OECD. The pursuit of gender equality: An uphill battle. OECD Publishing, Paris, 2017.
23. Action Aid. Make the house become home. Policy brief. Ha Noi, Viet Nam, 2016.
24. Kim EHW. Low fertility and gender inequity in developed Asian countries. Asian Popul Stud. 2018; 14:113-115.
25. Women UN. Unpaid care and domestic work: Issues and suggestions for Viet Nam. 2016. *https://asiapacific.unwomen.org/sites/default/files/Field%20Office%20ESEAsia/Docs/Publications/2017/01/Unpaid-Care-and-Domestic-Work-EN.pdf* (accessed September 28, 2023)
26. Basten S. Understanding ultra-low fertility in Hong Kong. In: Low and lower fertility (Rindfuss, RR, Choe MK, eds.). Springer International Publishing, 2015; pp.63-86.
27. Wallace C. Between state, market and family: Changing childcare policies in urban China and the implications for working mothers. International Sociology. 2020; 35:336-352.
28. Wei JQ, Xue JH, Wang DL. Socioeconomic determinants of rural women's desired fertility: A survey in rural Shaanxi, China. PLoS One. 2018; 13:e0202968.
29. Ji YC, Wang HG, Liu Y, Xu RN, Zheng ZZ. Young women's fertility intentions and the emerging bilateral family system under China's two-child family planning policy. China Review. 2020; 20:113-142.
30. Shen Y, Jiang L. Power relations in reproductive decisions under the transforming family planning policy in China. J Fam Issues. 2021; 43:2841-2867.
31. Thévenon O. Decreasing fertility in Europe: Is it a policy issue? Economics. 2016: 81-114.
32. United Nations Population Fund. The state of the world population 2018. New York, 2018. *https://www.unfpa.org/press/state-world-population-2018* (accessed September 28, 2023).
33. Rindfuss RR, Choe MK, Brauner-Otto SR. The emergence of two distinct fertility regimes in economically advanced countries. Popul Res Policy Rev. 2016; 35:287-304.
34. Clark WAV, Daichun Y, Zhang X. Do house prices affect fertility behavior in China? An empirical examination. Int Reg Sci Rev. 2020; 43:423-449.
35. Yi J. Zhang J. The effect of house price on fertility: Evidence from Hong Kong. Econ Inq. 2010; 48:635-650.
36. Saguin K. No flat, no child in Singapore: Cointegration analysis of housing, income, and fertility. ADBI Working Paper Series, No. 1231. Asian Development Bank Institute, Tokyo, 2021. *https://www.adb.org/sites/default/files/publication/689136/adbi-wp1231.pdf* (accessed September 28, 2023)
37. Lee S, Choi, H. Lowest-low fertility and policy responses in South Korea. In: Low and lower fertility (Rindfuss, RR, Choe MK, eds.). Springer International Publishing, 2015; pp.107-123.
38. Suzuki T. Korea's strong familism and lowest-low fertility. International Journal of Japanese Sociology. 2008; 17:30-41.
39. Sabermahani A, Goudarzi R, Nasiri S. Factors affecting fertility rate in Iran (panel data 1966–2013): A survey study. J Family Reprod Health. 2017; 11:138-145.
40. Hossein-Chavoshi M, Abbasi-Shavazi MJ, McDonald PF. Fertility, marriage, and family planning in Iran: Implications for future policy. Population Horizons. 2016; 13:31-40.
41. Hosseini M, Saikia U, Dasvarma G. The gap between desired and expected fertility among women in Iran: A case study of Tehran city. PLoS One. 2021; 16:e0257128.
42. Tsuya NO. Below-replacement fertility in Japan: Patterns, factors, and policy implications. In: Low and lower fertility (Rindfuss, RR, Choe MK, eds.). Springer International Publishing, 2015; pp.87-106.
43. Ma L. Economic crisis and women's labor force return after childbirth: Evidence from South Korea. Demogr Res. 2014; 31:511-552.
44. Caldwell JC. Social upheaval and fertility decline. J Fam Hist. 2004; 29:382-406.
45. Gietel-Baste S; Sobotka T. Trends in population health and demography. Lancet. 2021; 398:580-581.
46. Bergsvik J, Fauske A, Hart RK. Can policies stall the fertility fall? A systematic review of the (quasi-) experimental literature. Popul Dev Rev. 2021; 47:913-964.
47. Luci-Greulich A, Thévenon O. The impact of family policies on fertility trends in developed countries. Eur J

Population. 2013; 29:387-416
48. Gauthier AH. The impact of family policies on fertility in industrialized countries: A review of the literature. Popul Res Policy Rev. 2007; 26:323-346.
49. McDonald P. The emergence of low fertility as a policy issue. Asia Pac Popul J. 2007; 22:5-9.
50. Lowenson R, Masotya M, Mori R. Japan case study: Changing policies on the work-life balance in response to demographic challenges. Fostering policy support for family and child health and wellbeing. 2019. *https://www.tarsc.org/publications/documents/FCH%20Japan%20case%20study%202019.pdf* (accessed September 28, 2023).
51. Fukuda S, Matsukura R. Intergenerational transfer of care work: How technology would meet with future care demand in Japan and the UK? The 2022 WFRN (Work-Family Researchers Network) Conference, 2022. *https://researchmap.jp/fukuda-setsuya/presentations/38891957?lang=en* (accessed September 28, 2023).
52. Thévenon O. "Tackling child poverty in Korea". OECD Social, Employment and Migration Working Papers. 2018. 219.
53. Le H, Newman A, Menzies J, Zheng C, Fermelis J. Work-life balance in Asia: A systematic review. Human Resource Management Review. 2020; 30:100766.
54. England P, Privaalko I, Levine A. Has the Gender Revolution Stalled? Econ Soc Rev (Irel). 2020; 51:463-488.
55. England P. The gender revolution: Uneven and stalled. Gender & Society. 2010; 24:149-166.
56. The World Bank. Women, business and the law. 2023. *https://wbl.worldbank.org/en/data/exploretopics/wbl_gp* (accessed September 28, 2023).
57. International Labour Organization Regional Office for Asia and the Pacific. Game changers: Women and the future of work in Asia and the Pacific. 2018. *https://www.ilo.org/asia/publications/WCMS_645601/lang--en/index.htm* (accessed September 28, 2023)
58. Upadhyay UD, Gipson JD, Withers M, Lewis S, Ciaraldi EJ, Fraser A, Huchko MJ, Prata N. Women's empowerment and fertility: A review of the literature. Soc Sci Med. 2014; 115:111-120.
59. Kishor S, Subaiya L. Understanding women's empowerment: A comparative analysis of demographic and health surveys (DHS) data. 2008. *http://www.measuredhs.com/pubs/pdf/CR20/CR20.pdf* (accessed September 28, 2023).
60. Senarath U, Gunawardena NS. Women's autonomy in decision making for health care in South Asia. Asia Pac J Public Health. 2009; 21:137-143.
61. ESCAP. Unpaid work in Asia and the Pacific. Social Development Policy Papers. 2019. *https://repository.unescap.org/bitstream/handle/20.500.12870/816/ESCAP-2019-PB-Unpaid-work-AP.pdf?sequence=1* (accessed September 28, 2023).

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Assessment of skeletal muscle using deep learning on low-dose CT images

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Abstract: The visceral fat area obtained by computed tomography (CT) at the navel level is clinically used as an indicator of visceral fat obesity in Japan. Analysis of skeletal muscle mass using CT images at the navel level may potentially support concurrent assessment of sarcopenia and sarcopenic obesity. The purpose of this study was to assess the performance of deep learning models (DLMs) for skeletal muscle mass measurement using low-dose abdominal CT. The primary dataset used in this study included 11,494 low-dose abdominal CT images at navel level acquired in 7,370 subjects for metabolic syndrome screening. The publicly available Cancer Imaging Archive (TCIA) dataset, including 5,801 abdominal CT images, was used as a complementary dataset. For abdominal CT image segmentation, we used the SegU-net DLM with different filter size and hierarchical depth. The segmentation accuracy was assessed by measuring the dice similarity coefficient (DSC), cross-sectional area (CSA) error, and Bland-Altman plots. The proposed DLM achieved a DSC of 0.992 ± 0.012, a CSA error of 0.41 ± 1.89%, and a Bland-Altman percent difference of -0.1 ± 3.8%. The proposed DLM was able to automatically segment skeletal muscle mass measurements from low-dose abdominal CT with high accuracy.

***Keywords*:** deep learning, low-dose CT, skeletal muscle, image segmentation, sarcopenia

Introduction

Sarcopenia is a condition introduced by Rosenberg in 1989, and it refers to a decline in mass of skeletal muscle and reduced strength of muscles in the whole body, resulting in reduced physical performance. Frequently, sarcopenia occurs naturally due to aging. The term sarcopenia is derived from the Greek words "sarx" (muscle) and "penia" (loss) (*1*).

It has become clear that sarcopenia not only threatens the healthy life expectancy of the elderly, but it is also associated with various diseases and it may affect their prognosis. For example, the survival of individuals with solid tumors is worse if the skeletal muscle mass is lower (*2*). Moreover, patients with low muscle mass have been reported to be more likely to accumulate treatment-related events (*3,4*). In addition, sarcopenic obesity, which refers to a combination of skeletal muscle mass weakening and body fat accumulation, has become a topic issue in recent years. Patients with sarcopenic obesity have a higher prevalence of dyslipidemia than those with sarcopenia alone or obesity alone (*5*). The odds ratio of hypertension is equal to 1.5 in patients with sarcopenia compared to healthy subjects, and it becomes 2.08 times higher in patients with obesity and 3.0 times higher in patients with sarcopenic obesity (*6*). The odds ratio of metabolic syndrome is 1.98 times higher in patients with sarcopenia, and it becomes 7.53 times higher in patients with obesity, and 11.59 times higher in patients with sarcopenic obesity compared to healthy subjects (*7*).

One of the diagnostic indicators for sarcopenia is skeletal muscle mass. Skeletal muscle mass is assessed based on appendicular skeletal muscle mass measured by bioelectrical impedance analysis (BIA) or by dual-energy X-ray absorptiometry (DXA) (*8,9*). However, a high amount of adipose tissue limits the accuracy of BIA and DXA methods, as such the estimates of body composition in patients with obesity may not be accurate (*10*). Recently, single slices at various reference body levels measured by computed tomography (CT) have been adopted as a proxy for total muscle tissue volume (*11,12*). In Japan, the visceral fat area (VFA) measured by CT at the navel level is used as an indicator for visceral fat obesity, a type of obesity associated with a high risk of developing lifestyle-related diseases (*13*). Therefore, combined measurement of skeletal muscle mass in the trunk and VFA can be used to assess, concurrently,

sarcopenia, visceral fat obesity, and sarcopenic obesity.

An automated rule-based approach to VFA measurement on abdominal CT has been introduced in 2006. The use of CT images is promising in this field as CT can easily distinguish body components other than fat (*e.g.*, gas, water, blood, muscles, internal organs) by defining the fat range from -30 HU to -190 HU (*14*). Moreover, the rapid progress of deep learning algorithms, for example since Alexnet in 2012 (*15*) to U-net (*16*) in 2015, has greatly contributed to substantial developments in biomedical image segmentation and, to date, automated segmentation of skeletal muscle and other body tissues can be easily performed by using deep learning algorithms (*17-26*).

However, radiation exposure is a major barrier to widespread use of CT images and it limits the applications of CT to individual transversal images or secondary analysis of routine clinical measurements (*11*). In this context, the use of low-dose CT can help reduce issues related to human exposure and thus support a wider use of CT in diagnostics. However, the use of low-dose CT for muscle mass estimation has not been fully investigated so far (*22*). The purpose of this study was to assess the performance of deep learning for automatic skeletal muscle mass estimation using low-dose abdominal CT.

Materials and Methods

This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from each examinee regarding the use of his or her data for research purposes. This study was approved by the institutional review boards of Hitachi, Ltd. Hospital Management Headquarters (approval number: 2010-6). This study was based on retrospective analysis of a primary and a complementary dataset. The primary dataset included 11,494 subjects (10,241 men and 1,253 women; mean age, 57.0 ± 10.1 years), who underwent a low-dose abdominal CT at the navel level for metabolic syndrome screening at the Hitachi Health Care Center, Hitachi, Ltd. One or more images were taken around the navel level for each participant (1/2/3/4/5/6/7/8/9/10 slices = 3,349/3,925/95/0/0/0/0/0/0/1 participants). CT scans were performed at a CT dose index volume (CTDIvol) lower or equal to 2.5 mGy and an imaging range lower or equal to 5 cm, thus the exposure dose was lower or equal to 0.19 mSv. The complementary dataset was publicly available and was provided by the Cancer Imaging Archive (TCIA), funded by the Cancer Imaging Program (CIP), a part of the United States National Cancer Institute (NCI), and managed by the Frederick National Laboratory for Cancer Research (FNLCR) (*27*). This TCIA dataset included 5,801 low-dose abdominal CT images, including 2,691 slices from 22 men, 2,800 slices from 29 women, and 310 slices from 2 subjects with unspecified gender. Details of CT imaging settings of the two datasets are summarized in Table 1. The main dataset used one 5 mm-thick slice per participant, while the TCIA dataset used multiple images per examination reconstructed in finer slices of 1 to 1.25 mm.

The primary dataset was divided into Training, Tuning, and Internal validation sets and the TCIA dataset was divided into Training and Tuning sets. Training and Tuning used data taken from January 2017 to September 2018, while Internal validation used data taken from October 2018 to December 2018.

The slices for measuring skeletal muscle mass in the trunk are often measured at the 3rd lumbar spine level (*11*). However, the diagnostic index for metabolic syndrome in Japan is based on the cross-sectional area of visceral fat on abdominal CT slices at the navel level (*13*). Therefore, we built separate internal validation datasets using the upper and lower levels of the iliac crest. Details of the training, tuning, and internal validation sets are shown in Table 2.

For the sake of labeling the datasets using ground truth information, the psoas major and erector spinae muscles in each navel-level CT image were identified and manually annotated by a board-certified diagnostic radiologist (TN) with over 30 years of experience.

Our Deep learning model (DLM) was based on SegU-net (*28-30*). SegU-Net is a network structure which consists of encoders and decoders, like SegNet (*31*), linking encoder and decoder feature maps like U-Net (*16*), and using arbitrary specific hierarchies and filter sizes without cropping encoder feature maps.

We used the Exponential Linear Unit (ELU) as an activation function in the encoder and decoder processing and the max unpooling in the decoder processing. The

Table 1. CT imaging settings of the datasets used in this study

Items	Primary dataset	TCIA dataset
CT scanner	FUJIFILM Healthcare Supria Grande (64 rows)	Siemens Sensation (16 rows), Sensation (64 rows), GE LightSpeed Pro (16 rows), LightSpeed (16 rows), Philips Brilliance (40 rows)
Slice thickness	5 mm	1 to 1.25 mm
Body part	Abdomen (navel level)	Abdomen (around navel level)
Tube voltage	120 kVp	120 to 140 kVp
Tube current range	20 to 225 mA	115 to 280 mA
Low-dose CT	Yes	Yes
Pixel size (mm × mm)	(0.489 × 0.489) – (0.978 × 0.978)	(0.607 × 0.607) – (0.920 × 0.920)
Use of contrast agent	No	Yes

ELU is one of the activation functions and solves the dying Rectified Linear Unit (ReLU) problem, which showed that ReLU neurons become inactive and output only 0 for any input. The ELU contains the exponential function with the Euler number as the base, and returns a value of 0 or less if the input value is 0 or less while avoiding the ReLU-like vanishing gradient problem. The max unpooling means that the pixel value generated in the decoding process is applied to the pixel position showing the maximum value in the Max-Pooling layer in the encoding process, and all others are filled with zero. The architecture of the DLM used in this study is shown in Figure 1.

Table 2. Details of the training, tuning, and internal validation sets

Items	Training	Tuning	Internal validation	
			Upper level of iliac crest	Lower level of iliac crest
Primary dataset				
Men	7,001	1,762	1,156	322
Women	860	204	151	38
total	7,861	1,966	1,307	360
TCIA dataset				
Men	2,094	597	-	-
Women	2,180	620	-	-
Unknown	249	61	-	-
total	4,523	1,278	-	-

Original CT images were converted to normalized data of 512 × 512 size. No upper limit on the number of epochs was set. The best accuracy generation was identified at 863 epochs before overfitting was detected. Finally, 5 class regions (0: other, 1: right psoas, 2: left psoas, 3: left erector spinae, 4: right erector spinae) were defined as am image of 512 × 512 binary format.

The Dice similarity coefficient (DSC), the cross-sectional area (CSA) error and the Bland-Altman plot were performed to evaluate the segmentation performance of the proposed DLM using total and individual internal validation datasets from the upper and lower levels of the iliac crest.

The DSC was used to measure the similarity in the abdominal skeletal muscle area between the ground truth and the DLM outputs. The DSC is an index of spatial overlap ranging from 0 to 1. The DSC for the

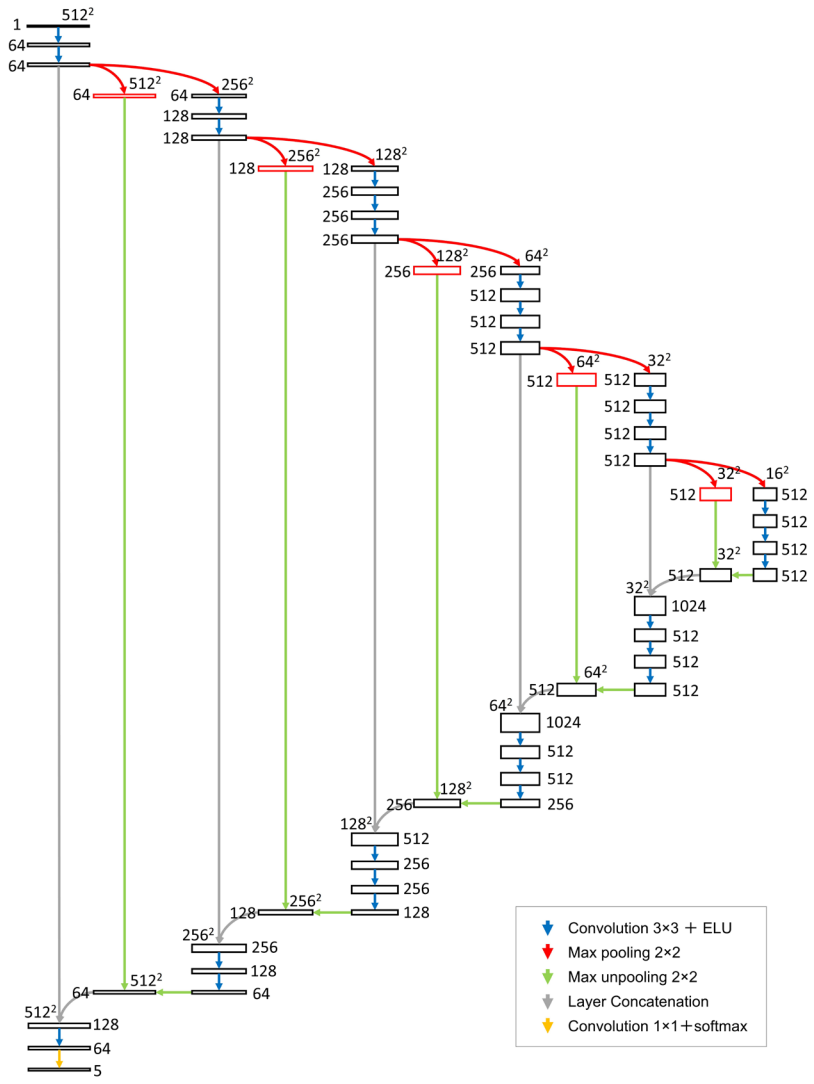

Figure 1. SegU-net architecture. Each black frame box corresponds to a multi-channel feature map. The number of channels is denoted on top or bottom of the box. The x-y-size is provided at the lower left or upper left edge of the box. Red frame boxes represent the pooling indices for max unpooling operation. The arrows denote the different operations.

combination of the right and left psoas major muscles (RPM and LPM) and for the right and left erector spinae muscles (REM and LEM) was calculated as follows.

DSC = (2 × (ground truth RPM∩calculated RPM)/ (ground truth RPM + calculated RPM) + 2 × (ground truth LPM∩calculated LPM)/ (ground truth LPM + calculated LPM) + 2 × (ground truth REM∩calculated REM)/ (ground truth REM + calculated REM)+ 2 × (ground truth LEM∩calculated LEM)/ (ground truth LEM + calculated LEM)) /4

The CSA error was also used to evaluate the segmentation accuracy of the proposed DLM. The lower the CSA error, the higher the segmentation accuracy. The CSA error for the combined muscle area (CMA) of the bilateral psoas major and erector spinae muscles calculated by the proposed DLM was computed as follows:

CSA error (%) = |ground truth CMA - calculated CMA|/ ground truth CMA ×100 (%)

The Bland-Altman plot was used to evaluate agreement between the estimated CMA and the ground truth. The mean and standard deviation (SD) of the difference between the estimated CMA and the ground truth were compared between men and women by *t*-test and F-test, respectively.

Results

The DSC was 0.992 ± 0.012, 0.993 ± 0.009, and 0.991 ± 0.019 for the total and the individual internal validation datasets from the upper and lower levels of the iliac crest, respectively. The CSA errors (%) were 0.41 ± 1.89, 0.35 ± 0.96, and 0.62 ± 3.62, respectively. The Bland-Altman plots for the CSA agreement between ground truth and DLM showed percent differences (mean ± 1.96 × SD) of -0.1 ± 3.8%, -0.05 ± 2.0%, and -0.2 ± 7.2%, respectively (Figure 2). Although there were statistically significant differences in means and SDs of the percent differences between men and women for the total (p = 0.006 and 0.008, respectively) and the upper levels of iliac crest (p = 0.0001 and < 0.0001, respectively) because of the

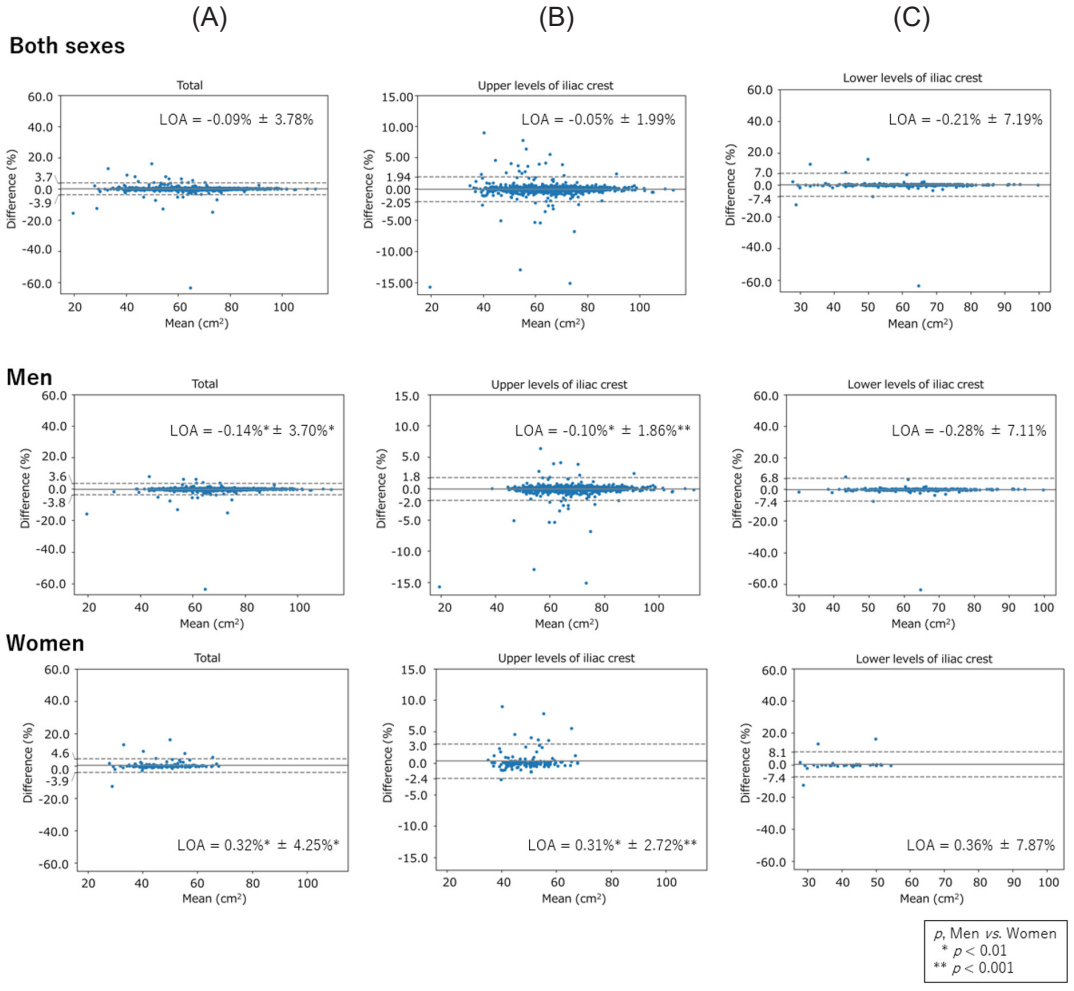

Figure 2. Bland-Altman plots for the CSA agreement between ground truth and DLM. **(A)** Total internal validation datasets, **(B)** Internal validation datasets from the upper levels of the iliac crest, **(C)** Internal validation datasets from the lower levels of the iliac crest. The solid line shows mean difference; the dotted line shows 95% limits of agreement (LOA: mean difference ± 1.96 × SD of the difference).

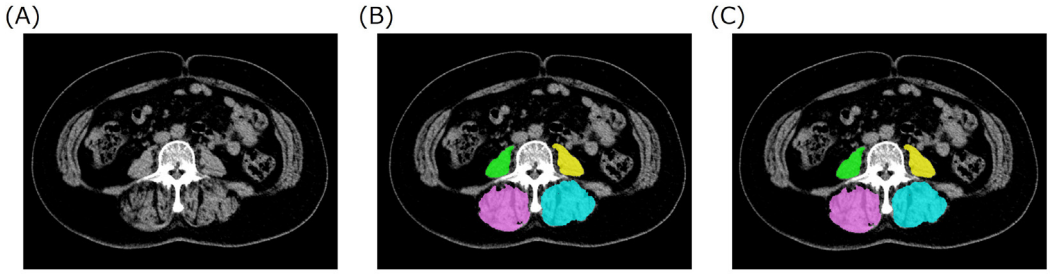

Figure 3. Example of good agreement between ground truth and DLM as DSC. (A) An original low-dose abdominal CT at navel level, **(B)** Ground truth segmentation, **(C)** DLM-derived segmentation of the right psoas major (RPM), the left psoas major (LPM), the right erector spinae (REM), and the left erector spinae (LEM) muscles in a woman's case (60 years old). Green = RPM, Yellow = LPM, Pink = REM, Blue = LEM.

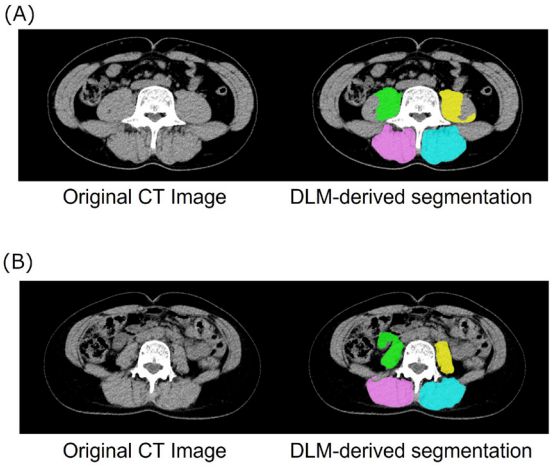

Figure 4. Cases with segmentation errors derived by the proposed DLM using internal validation dataset for the upper level of the iliac crest. (A) Case in which part of the muscle was missing, **(B)** Case in which part of the small intestine was segmented as muscle. Green = RPM, Yellow = LPM, Pink = REM, Blue = LEM.

large sample size, the differences in the actual values were very small. Figure 3 shows an exemplary case of successful segmentation of RPM, LPM, REM, and LEM.

Figure 4 shows cases with segmentation errors derived by the proposed DLM using internal validation dataset for the upper level of the iliac crest, where part of the muscle was missing or part of the small intestine was segmented as muscle.

Discussion

According to the 2019 Consensus of the Asian Working Group for Sarcopenia, the skeletal muscle mass index of the extremities using BIA and DXA is used for the diagnosis of sarcopenia in Asia (*32*). However, these measurements are not able to accurately estimate skeletal muscle mass in the trunk due to inherent limitations related to the measurement principles (*8,9*). Abdominal CT, as proposed in this study, enables measurement of the skeletal muscles of the trunk, and they can potentially become an essential technique for improving the accuracy of sarcopenia diagnosis.

However, risks related to radiation exposure represent a barrier to widespread use of CT and this imaging modality is not included in clinical recommendations for sarcopenia diagnosis. In this study, we introduced a DLM to assess skeletal muscles from low-dose CT images. The International Commission on Radiological Protection (ICRP) estimates that in a group of individuals including both adults and children, the probability of death due to cancer increases by an amount of about 0.5% per 100 mSv exposure (*33*), *i.e.* about 526 times the exposure of 0.19mSv associated with the abdominal CT scan used in this study. Future validation is needed to clarify whether the benefits of the use of low-dose CT for screening for sarcopenia and sarcopenic obesity outweigh the risks associated with radiation exposure.

Literature studies show that skeletal muscle assessment using CT scans at the level of the third lumbar (L3) spine is highly correlated with whole body skeletal muscle (*34,35*). However, this method requires adjustments on a case-by-case basis according to the target population. For example, Vangelov *et al.* (*36*) suggested to use the level of the 3rd cervical spine as an alternative because a malignant tumor confined to the head and neck usually does not require an abdominal CT. In this study, we found that the use of CT at the navel level, typically used for visceral fat area estimation in Japan, can provide accurate measurements.

The SegU-Net algorithm used here is a combination of SegNet (*31*) andU-Net (*16*). In SegNet, since encoder and decoder are connected in series, image details are lost in the process of propagating features, and the quality of segmentation of the original image is relatively low. In U-Net, the central portion of the feature map generated in each layer of the encoder is cropped to fit the feature map of the corresponding layer of the decoder. In the proposed SegU-net, the decoder uses unpooling to compensate for data deficiencies in the U-Net in place of upconvolution and cropping operations of the U-Net, to match coupling between encoder and decoder functions. In addition, in this study we also adopted the ELU as the activation function from the commonly used ReLu to solve the dying ReLU problem.

This study has several limitations. As a result of DLM-derived segmentation and validation on internal dataset by Ha *et al.* (*19*), the DSC was equal to 0.98, the CSA error (%) was equal to 1.22 ± 1.08%, and the percent difference of the Bland-Altman plots was equal to 0.2 ± 3.2%. For our DLM-derived segmentation, although DSC and CSA errors were comparable, the standard deviation observed using the total validation datasets and the validation datasets for the lower levels of the iliac crest was equal to 3.8% and 7.2%, respectively. Further research is needed to assess the variability of the observed results and to assess the distribution of the model performance, also including specific investigation of the outliers.

Moreover, the proposed DLM was not validated on external validation datasets. It will be important to identify further sources of data from different institutions to support external validation on varying datasets and assess generalization properties.

Also, in this study we did not measure the quadratus lumborum, latissimus dorsi, external oblique, internal oblique, transversus abdominis, and rectus abdominis muscles. Further studies will be necessary to assess accuracy for these muscles.

Last, but not least, the accuracy of visceral fat and subcutaneous fat measurements was not assessed. Moving towards future methods able to accurately measure sarcopenia, obesity, and sarcopenic obesity, further research is required, including specific investigation of the accuracy of visceral fat and subcutaneous fat measurements.

Conclusions

The proposed DLM was able to automatically segment skeletal muscles and assess muscle mass with high accuracy using low-dose abdominal CT images. Future research will be needed to assess the performance of the proposed method in a range of measurement settings and patient populations. The proposed DLM, may help build future automated methods to simultaneously evaluate sarcopenia, obesity, and sarcopenic obesity by measuring the navel-level visceral fat area and skeletal muscle mass using a single-slice low-dose CT.

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Conflict of Interest: The authors have no conflicts of interest to disclose.

References

1. Rosenberg IH. Summary comments (Epidemiologic and methodologic problems in determining nutritional status of older persons). Am J Clin Nutr. 1989; 50:1231-1233.
2. Shachar SS, Williams GR, Muss HB, Nishijima TF. Prognostic value of sarcopenia in adults with solid tumours: A meta-analysis and systematic review. Eur J Cancer. 2016; 57:58-67.
3. Antoun S, Baracos VE, Birdsell L, Escudier B, Sawyer MB. Low body mass index and sarcopenia associated with dose-limiting toxicity of sorafenib in patients with renal cell carcinoma. Ann Oncol. 2010; 21:1594-1598.
4. Raynard B, Pigneur F, Di Palma M, Deluche E, Goldwasser F. The prevalence of CT-defined low skeletal muscle mass in patients with metastatic cancer: a cross-sectional multicenter French study (the SCAN study). Support Care Cancer. 2022; 30:3119-3129.
5. Baek SJ, Nam GE, Han KD, Choi SW, Jung SW, Bok AR, Kim YH, Lee KS, Han BD, Kim DH . Sarcopenia and sarcopenic obesity and their association with dyslipidemia in Korean elderly men: The 2008-2010 Korea National Health and Nutrition Examination Survey. J Endocrinol Invest. 2014; 37:247-260.
6. Han K, Park YM, Kwon HS, Ko SH, Lee SH, Yim HW, Lee WC, Park YG, Kim MK, Park YM. Sarcopenia as a determinant of blood pressure in older Koreans: findings from the Korea National Health and Nutrition Examination Surveys (KNHANES) 2008-2010. PLoS One. 2014; 9:e86902.
7. Lu CW, Yang KC, Chang HH, Lee LT, Chen CY, Huang KC. Sarcopenic obesity is closely associated with metabolic syndrome. Obes Res Clin Pract. 2013; 7:e301-e307.
8. Sanada K, Miyachi M, Tanimoto M, Yamamoto K, Murakami H, Okumura S, Gando Y, Suzuki K, Tabata I, Higuchi M. A cross-sectional study of sarcopenia in Japanese men and women: Reference values and association with cardiovascular risk factors. Eur J Appl Physiol. 2010; 110:57-65.
9. Tanimoto Y, Watanabe M, Sun W, Hirota C, Sugiura Y, Kono R, Saito M, Kono K. Association between muscle mass and disability in performing instrumental activities of daily living (IADL) in community-dwelling elderly in Japan. Archives of gerontology and geriatrics. 2012; 54:e230-e233.
10. Jensen B, Braun W, Geisler C, Both M, Klückmann K, Müller MJ, Westphal AB. Limitations of fat-free mass for the assessment of muscle mass in obesity. Obes Facts. 2019; 12:307-315.
11. Walowski CO, Braun W, Maisch MJ, Jensen B, Peine S, Norman K, Müller MJ, Westphal AB. Reference values for skeletal muscle mass - Current concepts and methodological considerations. Nutrients. 2020; 12:755.
12. Derstine BA, Holcombe SA, Ross BE, Wang NC, Su GL, Wang SC. Skeletal muscle cutoff values for sarcopenia diagnosis using T10 to L5 measurements in a healthy US population. Sci Rep. 2018; 8:11369.
13. Examination Committee of Criteria for 'Obesity Disease' in Japan; Japan Society for the Study of Obesity. New criteria for 'obesity disease' in Japan. Circ J. 2002; 66:987-992.
14. Zhao B, Colville J, Kalaigian J, Curran S, Jiang L, Kijewski P, Schwartz LH. Automated quantification of body fat distribution on volumetric computed tomography. J Comput Assist Tomogr. 2006; 30:777-783.
15. Krizhevsky A, Sutskever I, Hinton GE. ImageNet classification with deep convolutional neural networks. *https://proceedings.neurips.cc/paper_files/paper/2012/file/c399862d3b9d6b76c8436e924a68c45b-Paper.pdf*

(accessed September 1, 2023)
16. Ronneberger O, Fischer P, Brox T. U-net: Convolutional networks for biomedical image segmentation. *https://link.springer.com/chapter/10.1007/978-3-319-24574-4_28* (accessed September 1, 2023)
17. Amarasinghe KC, Lopes J, Beraldo J, Kiss N, Bucknell N, Everitt S, Jackson P, Litchfield C, Denehy L, Blyth BJ, Siva S, MacManus M, Ball D, Li J, Hardcastle N. A deep learning model to automate skeletal muscle area measurement on computed tomography images. Front Oncol. 2021; 11:580806.
18. Cespedes Feliciano EM, Popuri K, Cobzas D, Baracos VE, Beg MF, Khan AD, Ma C, Chow V, Prado CM, Xiao J, Liu V, Chen WY, Meyerhardt J, Albers KB, Caan BJ. Evaluation of automated computed tomography segmentation to assess body composition and mortality associations in cancer patients. J Cachexia Sarcopenia Muscle. 2020; 11:1258-1269.
19. Ha J, Park T, Kim HK, Shin Y, Ko Y, Kim DW, Sung YS, Lee J, Ham SJ, Khang S, Jeong H, Koo K, Lee J, Kim KW. Development of a fully automatic deep learning system for L3 selection and body composition assessment on computed tomography. Sci Rep. 2021; 11:21656.
20. Park HJ, Shin Y, Park J, Kim H, Lee IS, Seo DW, Huh J, Lee TY, Park TY, Lee J, Kim KW. Development and validation of a deep learning system for segmentation of abdominal muscle and fat on computed tomography. Korean J Radiol. 2020; 21:88-100.
21. Perez AA, Pickhardt PJ, Elton DC, Sandfort V, Summers RM. Fully automated CT imaging biomarkers of bone, muscle, and fat: Correcting for the effect of intravenous contrast. Abdom Radiol (NY). 2021; 46:1229-1235.
22. Pickhardt PJ, Perez AA, Garrett JW, Graffy PM, Zea R, Summers RM. Fully automated deep learning tool for sarcopenia assessment on CT: L1 versus L3 vertebral level muscle measurements for opportunistic prediction of adverse clinical outcomes. AJR Am J Roentgenol. 2022; 218:124-131.
23. Weston AD, Korfiatis P, Kline TL, Philbrick KA, Kostandy P, Sakinis T, Sugimoto M, Takahashi N, Erickson BJ. Automated abdominal segmentation of CT scans for body composition analysis using deep learning. Radiology. 2019; 290:669-679.
24. Bridge CP, Rosenthal M, Wright B, *et al.* Fully-Automated Analysis of Body Composition from CT in Cancer Patients Using Convolutional Neural Networks. *https://link.springer.com/chapter/10.1007/978-3-030-01201-4_22#citeas* (accessed September 1, 2023)
25. Graffy PM, Liu J, Pickhardt PJ, Burns JE, Yao J, Summers RM. Deep learning-based muscle segmentation and quantification at abdominal CT: Application to a longitudinal adult screening cohort for sarcopenia assessment. Br J Radiol. 2019; 92:20190327.
26. Burns JE, Yao J, Chalhoub D, Chen JJ, Summers RM. A machine learning algorithm to estimate sarcopenia on abdominal CT. Acad Radiol. 2020; 27:311-320.
27. Clark K, Vendt B, Smith K, Freymann J, Kirby J, Koppel P, Moore S, Phillips S, Maffitt D, Pringle M, Tarbox L, Prior F. The Cancer Imaging Archive (TCIA): Maintaining and operating a public information repository. J Digit Imaging. 2013; 26:1045-1057.
28. Rocha J, Cunha A, Mendonça AM. Conventional filtering versus U-Net based models for pulmonary nodule segmentation in CT images. J Med Syst. 2020; 44:81.
29. Bianco M, Giri SK, Iliev IT, Mellema G. Deep learning approach for identification of H II regions during reionization in 21-cm observations. Monthly Notices of the Royal Astronomical Society. 2021; 505:3982-3997.
30. Jeon S, Choi W, Park B, Kim C. A deep learning-based model that reduces speed of sound aberrations for improved *in vivo* photoacoustic imaging. IEEE Trans Image Process. 2021; 30:8773-8784.
31. Badrinarayanan V, Kendall A, Cipolla R. Segnet: A deep convolutional encoder-decoder architecture for image segmentation. IEEE Trans Pattern Anal Mach Intell. 2017; 39:2481-2495.
32. Chen LK, Woo J, Assantachai P, *et al.* Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc. 2020; 21:300-307.e2.
33. Ministry of the Environment Government of Japan. BOOKLET to Provide Basic Information Regarding Health Effects of Radiation 2nd edition: Chapter 3 Health Effects of Radiation: Risks of Health Effects of Radiation. *https://www.env.go.jp/en/chemi/rhm/basic-info/1st/03.html* (accessed September 1, 2023)
34. Shen W, Punyanitya M, Wang Z, Gallagher D, St-Onge MP, Albu J, Heymsfield SB, Heshka S. Total body skeletal muscle and adipose tissue volumes: Estimation from a single abdominal cross-sectional image. J Appl Physiol (1985). 2004; 97:2333-2338.
35. Mourtzakis M, Prado CM, Lieffers JR, Reiman T, McCargar LJ, Baracos VE. A practical and precise approach to quantification of body composition in cancer patients using computed tomography images acquired during routine care. Appl Physiol Nutr Metab. 2008; 33:997-1006.
36. Vangelov B, Bauer J, Moses D, Smee R. A prediction model for skeletal muscle evaluation and computed tomography-defined sarcopenia diagnosis in a predominantly overweight cohort of patients with head and neck cancer. Eur Arch Otorhinolaryngol. 2023; 280:321-328.

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Effects of the project on enhancement of teaching skills in gerontic nursing practice of Indonesian nursing lecturer and clinical nurse preceptor

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Abstract: The Indonesia health care services require knowledgeable and skilled nurses as professional service providers, especially in a gerontic nursing area. Moreover, widening the gap between academic and clinical practice is also an issue, which affects the care service quality. In these circumstances, the project to enhance the educational skills of nursing lecturers and clinical nurse preceptors in gerontic nursing practice was started in 2020. Japanese nursing education experts provided guidance on the principle theory of nursing practice in basic nursing education and conducted workshops to develop nursing practice materials for 10 Indonesian trainees. The project provided 3 webinars for more than 100 Indonesian nursing lecturers and preceptors each time, 18 workshops and developed 2 virtual reality (VR) materials, 8 supervisions of the trial class and 5 lectures onsite and online. This study aimed to clarify the effects of the project evaluated in the process and its impact using a questionnaire survey and interviews conducted. The results of the questionnaire survey for students showed that 20% of their knowledge and skills in gerontic nursing, increased and the extent of understanding and satisfaction was high. Lecurers and preceptors perceived improvement in their teaching skills, especially in theoretical thinking and evidence-based teaching methods. Notably, "the evaluation from others" would be a facilitating factor of the project. The project effects were clarified and achieved the goal and objectives of the project.

***Keywords*:** basic nursing education, Unification between academic and clinical settings, virtual reality

Introduction

In order to achieve Universal Health Coverage (UHC) in Indonesia, securing with proper allocation of healthcare professionals especially nurses is urgent. The density of health personnel in the latest available data in Indonesia is doctors at 7.0, and nurses and midwives at 11.2 per 10,000 population (*1*). These figures indicate this is not always sufficient for the population in Indonesia. Moreover, Indonesia is struggling with the maldistribution of health personnel due to remote areas like other island countries. Both the quantity and the quality of nurses are required to maintain the needed healthcare services (*2*). Nursing education is characterized by providing nursing students with the education that is necessary to provide high-quality care to clients. Investment in nursing education includes an effort to improve and maintain the quality of care. The health care services in Indonesia also require knowledgeable and skilled nurses as professional service providers. In a specific Indonesian context, there are two main considerations to improve the quality of nursing. The first is a high need for the acquisition of educational skills in gerontic nursing to address more complex health problems including care for older individuals. Indonesia is facing an ageing society (*3*). In Indonesia, the nursing education curriculum has been amended since 2019 under the Indonesian Qualification Framework, which compares balances and integrates education and training sectors, as well as job experiences, in a scheme of competence acknowledgement for specific occupational requirements (*4*). Nurse professionals require a qualification of diploma III at the equivalent of Indonesian Qualification Framework 5 and above (Figure 1). This means that a nurse's competency is based on a certain basic educational level stipulated by the framework and is guaranteed. However, in this educational system, gerontic nursing education is still new, for instance, the master course in gerontic nursing has just been introduced. Nursing faculty members who could teach gerontic nursing are too little even though there is a huge demand for elderly care by qualified nurses. The second is the gap between academic and clinical practice, which has been well documented (*5-7*). Education always needs to respond to the rapidly

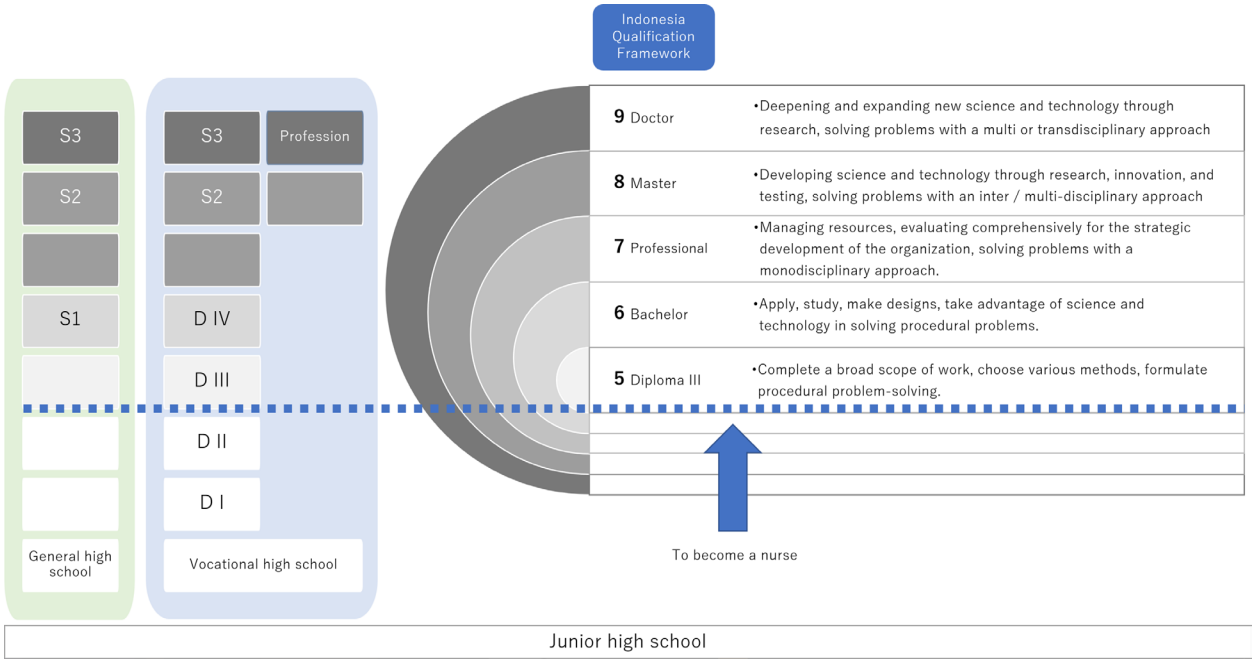

Figure 1. Nursing professional in the Indonesia Qualification Framework. A mutual equivalence toward IQF qualification levels between education pathways both formal and non-formal and occupational/career pathways. To become a nurse is required a qualification of diploma III at the equivalent of Indonesian Qualification Framework 5 and above. The figure has been modified from the Indonesian Qualification Framework (4) and produced originally by the authors.

changing needs of clinical practice and advanced clinical care, however, the real clinical setting is not the same as in the textbook. It has been reported that nursing teachers, nursing students and clinical nurse preceptors experience a theory-practice gap and their mutual concerns as such are insufficient clinical placements, sequencing of theory and practice, lack of collaboration between clinical practice settings and educational institutions and unclear links to teacher roles (*8*).

Considering these circumstances and issues of nursing education in Indonesia, the researchers started the "Enhancing educational skills in basic nursing education in Indonesia (focus on gerontic nursing)" in 2020 (*9*). It was conducted in the Projects for Growth of Medical Technologies (TENKAI Project), which is implemented by the Bureau of International Health Cooperation, National Center for Global Health and Medicine (NCGM). The TENKAI project is designed to share Japan's knowledge and experience in the medical field and promote international deployment of Japanese technology to meet the needs of low and middle-income countries, and is being implemented in more than 30 countries. Our Indonesia nursing education project aimed to improve the gerontic nursing education skills of Indonesian nursing lecturers and clinical nurse preceptors. By improving their education skills through this project, nursing students and novis clinical nurse preceptors could receive better instruction from ttrainees of our project, who are nursing lecturers and clinical nurse preceptors. Therefore, the project would contribute to improving the quality of elderly care in Indonesia in order to provide care by nurses who have obtained high-quality gerontic nursing education. Furthermore, by responding to Indonesia's need for training nursing lecturers and clinical nurse preceptors in gerontic nursing education, the project would be Japan's international contribution toward the achievement of UHC in that country.

The study aimed to clarify the effects of the project "Enhancing educational skills in basic nursing education in Indonesia (focus on gerontic nursing)". In previous studies, no studies on improving the educational skills of Indonesian nurse lecturers or clinical nurse preceptors were found in English. A qualitative study reported individual, orgnizational and systematical efforts to maintain and improve the competency of Indonesian clinical nurses (*10*). Another study involving physiotherapy clinisians and students revealed the improvement of their educational skills through a simulation learning intervention by randomized controlled trial (RCT) (*11*). The study using the data from the planned project with a specific target population and intervention methods would be beneficial for the improvement of Indonesian nursing education. Moreover, integrating and synthesising the findings of multiple evaluations of a particular type of program can inform policy-making and program planning (*12*). Evidence of project effects is meaningful and would be expected to be utilized in several countries with similar contexts.

Materials and Methods

Overview of the project

The project "Enhancing educational skills in basic

nursing education courses in Indonesia (focus on gerontic nursing)" was conducted by the National College of Nursing, Japan (NCNJ) and the National Center for Global Medicine (NCGM) including seven nursing educators. The project manager and two sub-managers had experience in nursing education for around 20 years, and the project manager was an expert in the gerontic nursing area. The NCNJ was established by the Ministry of Health, Labour and Welfare, Japan in 2000, and has been one of the departments of NCGM. The NCNJ provides both undergraduate and graduate education in nursing science and is assigned to provide training for nurses with continuous professional development as well.

The project started in April 2020 and finished in March 2023, as a three-year project. The project goal was to acquire and enhance effective teaching methods and skills in gerontic nursing for Indonesian nursing lecturers and clinical nurse preceptors, with the following four specific objectives: *i*) to understand theoretically and systematically the role of nursing practice in basic nursing education, and planning and evaluation of nursing practice; *ii*) to understand effective methods of online practice; *iii*) to develop gerontic nursing practice materials with VR technology and conduct trial classes; and *iv*) to produce nursing practice materials independently in Indonesia and wider spread use throughout the country (Figure 2).

In 2020, first we conducted a needs assessment and explored the most adequate project provision. During the pandemic, trainees had needs to find out better nursing practice methods, it should be conducted not only online but also onsite or in a blended style after becoming the new normal. After discussion among project team members, we conducted a two-day webinar focusing on the significance and situations of nursing practice in the clinical setting and gerontic nursing in basic nursing education, teaching and evaluation methods of nursing practice, as well as effective online practice. We also invited guest lectures from directors of Ikatan Perawat Gerontik Indonesia (IPEGERI, Indonesian gerontic nurse association) and Asosiasi Institusi Pendidikan Ners Indonesia (AIPNI, Association of Indonesian Nurses Education Center) to understand the gerontic nursing education situation in Indonesia shareing their experiences. These lectures were an opportunity to learn about the medical care environment for the elderly and the characteristics of gerontic nursing education in Indonesia from sources with a wider scope. The webinar promoted the improvement of basic knowledge of elderly nursing in basic nursing education for the participants. Moreover, the direction of the project was confirmed to be acceptable at the end of 2020.

In 2021, based on the knowledge acquired through the 2020 training, online teaching materials were developed in collaboration wtih trainees, and specific lesson plans and teaching points were taught in the workshop. The teaching materials utilised VR technology, which enables a more realistic immersion and presense in nursing practice experience, even online. Trainees selected two cases that incorporated the reality of life in Indonesia (Case1: repositioning an older patient with bedsores and reduced level of consciousness; Case 2: discharge education for family member about transferring and moving an older patient with right-sided hemiplegia with a wheelchair). In January 2022, a webinar was held to

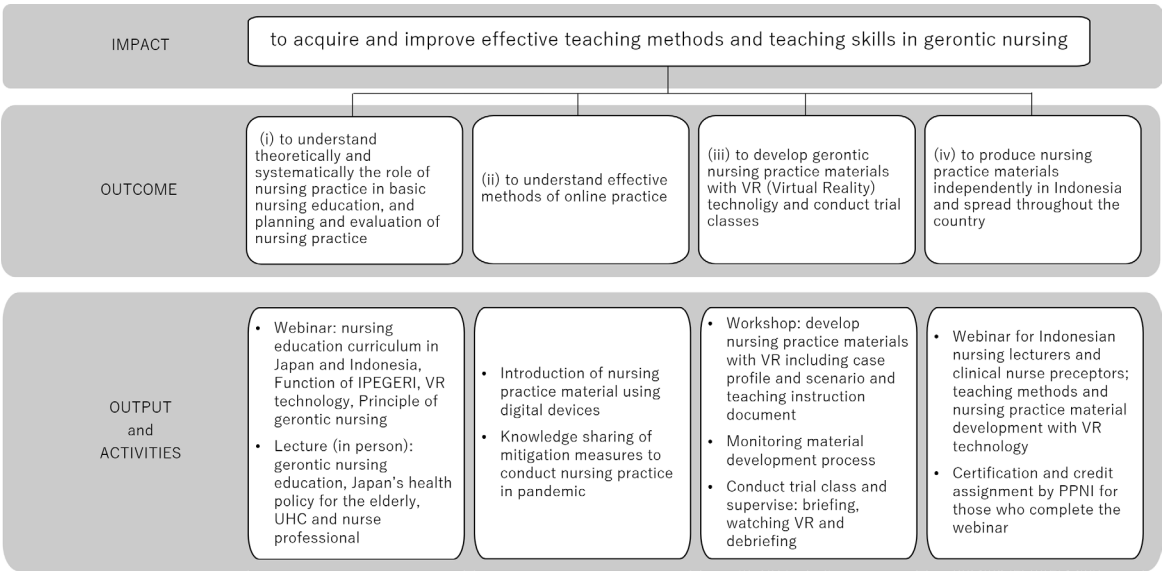

Figure 2. Logic model of the project "Enhancing educational skills in basic nursing education courses in Indonesia (Gerontic nursing)". The final outcome as an impact of the project was determined first based on the dialogue with participants in the needs assessment phase. After the project's direction, the project outcome was discussed with trainees and other stakeholders including a Japanese company that partially joined in activities developing nursing practice materials with VR technology. Activities were also discussed rationalised with the outcomes and revised after confirming achievability and reality in the mid and end of the fiscal year. VR: virtual reality.

disseminate the developed nursing practice materials to Indonesia overall.

In 2022, the possibility of introducing nursing practice classes using VR materials into the curriculum of Indonesian basic nursing education institutions and their spill-over potential are being examined. So, the class was called the trial class. The trial classes were initiated for 20 students at each institution supported by other nursing lecturers involved except a trainee. VR goggles were supplied with the project budget. Japanese project members supervised, mainly just observing the class with an interpreter. A total of five institutions conducted the trial class, one institution in June, two institutions in July and two institutions in September. Before and after the trial class, the questionnaire survey to the students who participated in the class, which was set as one of the project evaluation indicators, was conducted by the project members. In January 2023, the final webinar was held involving deans of the trainees' institutions. In February 2023, the integration meeting with PPNI and AIPNI was conducted to discuss mutual support to enhance teaching skills in nursing education.

Participants of the project

The trainees of the project were 10 Indonesian nursing lecturers and clinical nurse preceptors. Some of them were called based on the Japan International Cooperation Agency (JICA) project "Enhancement of the nursing competency through in-service training" 2012–2017 and participated in the project, the others were recruited using personal connections. They joined the project through their free will but with permission from their affiliated institutions. Both academic and clinical institutions intended to be involved in the project due to strengthening unification between educational and clinical practice settings in the development of nursing personnel. Therefore, their affiliations were from faculty of nursing in universities, polytechnics and top referral hospitals. Notably, Trainee 1 was also a director of the IPEGERI, which has duties and responsibilities of developing the knowledge and practice of gerontic nursing. The Central Board of the IPEGERI is the Board of the Persatuan Perawat Nasional Indonesia (PPNI, Indonesian National Nurses Association) complementary body that supports the development of gerontic nursing science and practice in Indonesia, which is collective in nature and subject to and obedient to PPNI organizational Decrees and Regulations (*13*).

Nursing students and nurses in a clinical setting who participated in the trial class to demonstrate using nursing practice materials developed in the project were ancillary participants. Around 20 students or nurses joined the trial class on a voluntary basis.

The project team obtained cooperation from a Japanese company, which is an educational manufacturer and a leading company in developing medical simulators, to develop nursing practice materials with virtual reality (VR) technology.

Research Concept

The project was evaluated in the process and its impact (Figure 3).

Process evaluation

Process evaluation examined what a program was, the activities undertaken, who and how received training or other benefits, and the consistency with which it is implemented in terms of its design and across sites (*12*). The project process was evaluated according to Six Components of Comprehensive Process Evaluation (*14*), but there is no established evaluation methodology so far. The list of components includes fidelity, does delivered,

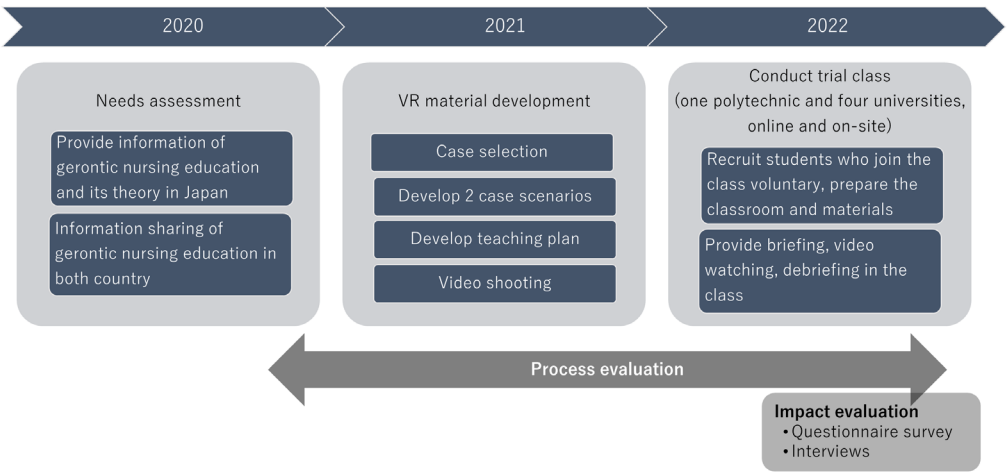

Figure 3. The project flow and the research concept. This is a schematic diagram of the flow of the project implementation and the research concept. The project was implemented to achieve set outcomes and evaluation was done based on the concept of process and impact. A questionnaire survey and interviews were conducted to evaluate the project's impact in the impact evaluation. VR: virtual reality.

does received, satisfaction, reach and recruitment.

Fidelity means the extent to which the programme was implemented consistently with underlying theory design and philosophy. Does delivered is measured amounts or number of intended to deliver are planned by the programme staff. Does received is evaluated in the extent to which participants actively engage with, interact with, are receptive to and/or use materials or resources including initial use and continued use. Satisfaction means participants, both direct and indirect, satisfaction with the programme and interactions with staff. Reach means proportion of the priority intended beneficiaries who participated in the programme. And, recruitment means procedures used to approach and attract programme participants at the individual or organization level.

Impact evaluation

The project impact was to improve trainees' teaching skills in gerontic nursing practice, and was evaluated using mixed methods with a concurrent triangulation design (*15*). In order to clarify the project impact, the data from the project were used including: pre and post-test results of nursing students in the trial class using developed practice materials with VR technology, and interviews with trainees.

Methods of impact evaluation

Questionnaire survey

Five nursing lecturers out of ten project trainees including both nursing lecturers and clinical nurse preceptors conducted the trial classes using developed nursing practice materials with VR technology at one polytechnic and four nursing faculties between June and September 2022.

The participants of the questionnaire survey were 20 nursing students in five institutions, who had already studied gerontic nursing in their own institution's curriculum. Pre- and post-test contained the same 20 items of knowledge and skills related to the trial class contents and gerontic nursing to identify the changes before and after the class. The other 10 items were collected only after the class to clarify the extent of students' understanding and satisfaction. Pre- and post-tests scores were calculated from the correct answer rate in percentage. The extent of understanding and satisfaction were evaluated with a five-range Likert scale. The data were analyzed descriptively.

Interviews

Semi-structured interviews were conducted for the trainee of the project 10 Indonesian nursing lecturers and clinical nurse preceptors (Table 1) in August 2022 and from September 2022 to January 2023. An interview guide was used that was developed based on the Kirkpatrick Model (*16*). The model originally comprises four levels to evaluate the programme but only Levels 1 and 2 were used in this study for the project evaluation because of limited steps of the project (Table 2). Interview participants were 10 trainees including both nursing teachers and clinical nurse preceptors and were interviewed through a Japanese-Indonesian interpreter. Informed consent in their native language was conducted before being interviewed. All interviews were audio-recorded and verbatim transcriptions were developed in Japanese.

Content analysis (*17*) was conducted using the qualitative data analysis software MAXQDA Plus2020 (*18*). Transcribed data was analyzed by three Japanese researchers including the interviewers, who were well experienced with thematic analysis. First, sentences meaningful to reveal the effects of the project were extracted, and then the codes were generated from the sentences. Categories were defined and named based on the codes' similarity. Interpretation in the context and validity of results were confirmed over repeated discussions with analysis team members in the process.

Ethical considerations

All the research participants, including the project trainees and the students in the trial classes, were given a detailed explanation of the purpose and method of the

Table 1. Characteristics of trainees (Nursing lecturers and clinical nurse preceptors)

Trainee	Age*	Educational background**	Affiliation Academic/ Clinical	Vice Dean / Director	Team Leader / Manager	Lecturer / Head Nurse
1	58	S3	Both	✓		
2	60	S3	Academic	✓		
3	47	S2	Clinical		✓	
4	49	S2	Academic		✓	
5	41	S1	Clinical			✓
6	39	S2	Academic			✓
7	42	S1	Clinical			✓
8	42	S2	Academic		✓	
9	39	S2	Academic			✓
10	34	S2	Clinical			✓

*As of interview date. **S1: Bachelor in Nursing. S2: Master of Nursing Science, S3: Doctor of Philosophy.

Table 2. Interview guide for of the project trainees (Nursing lecturers and clinical nurse preceptors)

Level	Questions
Level 1: Reaction	Satisfaction
	• Was the project content information you wanted to know for teaching skills of practice? What information was it?
	• What was the project content that interested you?
	• Were you satisfied with the project? What did you find satisfying about it?
	• What did you expect from this project that didn't work out?
	• Which projects would you like to be joined in the future?
	Engagement
	• Were you able to actively participate in the project? Please specify.
	Relevance to your work
	• What have you learnt about your teaching skills in gerontic nursing?
	• What is the content of the project that could be useful for teaching skills?
	• What is the project content that you could immediately utilise in your teaching?
Level 2: Learning	Status of acquisition of knowledge and skills
	• Did you understand the content of the project? What was it?
	• Have your teaching skills improved through the project? Why do you think so?
	• What are the difficulties you face when trying to put them into practice?
	Confidence
	• Are you confident in using the content of the project in your teaching? What is it?
	• What are the things you are not confident about?
	Commitment
	• What is the project content that you intend to utilise in practice teaching and what are the hiding factors, if any, in doing so?
	• Do you think the experiences and learnings from this project can be used for nursing education in Indonesia in the future, and why?

project and the research. They were also assured that the research participation was voluntary, the collected data would be kept secure and confidential, and no identifiable information would be disclosed in the published paper. This study was approved by the Ethical Review Committee of the National Center for Global Health and Medicine (NCGM-S-004473-00).

Results

Implementation of the project

During the project periods, from April 2020 to February 2023, activities were conducted as follows; 3 times webinars; 18 times workshops for developing nursing practice materials using VR; 2 times VR video shootings in the NCNJ lab and narration recorded by Indonesian trainees; 8 times supervisions of the trial classes; and 5 times educational lectures including basics of gerontic nursing education and Japan's health system. Additionally, technical meetings with project members and/or trainees were held about once a month, attendance of trainees were more than 90%.

The webinar were conducted for Indonesian nursing lecturers and clinical nurse preceptors to share experiences of the project. The webinar participants in 2021, 2022 and 2023 were 179, 100 and 239, respectively. The webinar was approved as one of the PPNI-accredited training courses that are required for the renewal of nursing licences. The participants in the webinar were issued a certificate of PPNI continuing education credit points. The participants expressed high satisfaction with each webinar, especially the developed VR materials for nursing practice were positively evaluated in terms of usefulness and feasibility in their institutions in Indonesia.

In the process of developing VR materials, all the project members spent 18 times in workshops with the trainees to achieve it. The trainees were split into two groups by case and used their time to discuss developing case profiles and case scenarios within the groups. The Japanese company, which was a leading company in medical educational manufacturers, shot the VR video following their expertized experiences. It was left for nursing lecturers to decide how to actually prepare and develop the classes based on their lesson plans. Therefore, we could learn how they had devised ways to facilitate the students to learn and understand the cases better by distributing handouts of the two cases in advance, and how students fully understood the teaching points described in the lesson plans from the supervision of the trial classes.

Conducting the trial classes by trainees themselves meant good opportunities that they felt accomplished one goal after having a hard time in developing VR materials and lesson plans with significant teaching points in gerontic nursing. The details of the questionnaire survey conducted before and after the trial classes are explained in the next section.

Questionnaire survey

The results of the questionnaire survey are shown in Table 3. A total of 100 students participated in the

trial class using nursing practice materials with VR technology. The overall percentage of correct answers to the questionnaire related to the contents of the class and knowledge and skills of gerontic nursing, was 55% on pre-test and 66% on post-test. The maximum and minimum percentages of items answered correctly were 18% and 94% on pre-test and 14% and 99% on post-test, respectively.

The extent of students' understanding and satisfaction with the trial class conducted showed an average of more than 4.5 points in the 5-point Likert scale from strongly disagree (1) to strongly agree (5).

Interview

In total, 82 segments regarding the effects of the project perceived by the trainee were extracted from the descriptive data interviewed (as shown in Table 1). The segments were categorized into 10 codes (Table 4); having the confidence to utilise the skills learned from the project; knowing attractive teaching methods using VR; improving the teaching skills in gerontic nursing practice; finding a new and or advanced theme to learn; understanding the necessity to provide rationales for the care process; exploring the way for students to think about and obtain new ideas; updating the knowledge regarding gerontology; sharing teaching points in written documents; making an opportunity to be evaluated by others officially; and being a trigger to fill the gap between the clinical and academic.

Discussion

The purpose of this study was to clarify the effects of the project "Enhancing educational skills in basic nursing education in Indonesia (focus on gerontic nursing)". The main findings of this study were that the project was implemented theoretically, and simultaneously, trainees' contributions and active participation were conspicuous. Consequently, the project achieved the effect of enhancing the teaching skills in gerontic nursing practice, as evidenced by both results of the questionnaire survey by students and interviews by trainees.

First, the project was evaluated in the scope of process evaluation. The goal of this project is to enhance gerontic nursing education skills for Indonesian nursing lecturers and clinical nurse preceptors. To achieve this goal, the project implementors provided the webinars, workshops and lectures, supported developing nursing practice materials and conducted the trial classes. These inputs were done in a consistent manner. All project activities were delivered to the intended persons, and all students and trainees were supplied with goggles to watch the VR video properly. Both the trainees and the nursing students who joined the trial class expressed high satisfaction in trainees' interview as well as the students' narrative data of the questionnaire survey. Therefore, the project has been completed with fidelity.

Second, the impact of the project was evaluated quantitatively and qualitatively. Students' scores in gerontic nursing knowledge and skill partially reflected the competency of the lecturers who provided the class. The students who took the class would get a good score if the lecturer taught the students with sufficient teaching skills. In this study, the score on the post-test increased 20% from the score on the pre-test. This suggests that the nursing lecturer, who is a trainee of the project, conducts attractive, interactive, and an understandable class. As the results of the interviews show, the trainees perceived their enhancement of teaching skills during the project,

Table 3. Demographic data of nursing students who joined the trial class (*n* =100)

Items		*n*	%
Sex	female	88	88.0
Semester in completing gerontic nursing education	5th	22	22.0
	6th	30	30.0
	7th	29	29.0
	8th	19	19.0
		Mean (SD)	
Age, years		20.8 (0.69)	
Correct answer rate	pre-test	55.3 (21.95)	
	post-tests	66.1 (27.36)	
Understanding and satisfactio (range:0-5)			
(1) I was able to understand the content of the class well		4.6 (0.51)	
(2) Satisfied with the content of the class		4.7 (0.52)	
(3) I was able to understand nursing care for the elderly well		4.7 (0.52)	
(4) The case patient situation was easy to understand		4.8 (0.53)	
(5) This class is effective as an alternative nursing practice in hospital or lab		4.9 (0.53)	
(6) VR will be supplementary practice materials in hospital or lab training		4.9 (0.53)	
(7) I understood the actual care procedures well by using the VR		4.5 (0.56)	
(8) It was easy to use the VR		4.5 (0.61)	
(9) Internet connection was stable and I was able to watch videos and audio without interruption		4.4 (0.70)	
(10) VR videos made me dizzy and sick		3.2 (1.08)	

VR: virtual reality.

Table 4. Effects of the project "Enhancing educational skills in basic nursing education courses in Indonesia (Gerontic nursing)" perceived by trainees (*n* =82)

Codes	Related segments	# of segments
Having the confidence to utilise the skills learned from the project	• In promoting education using VR nursing practice materials at our school, we have already conducted training twice this year. • I would have the training that I learned in this project with my colleague due to the limited specialized knowledge of elderly care of more experienced nurses.	12
Knowing attractive teaching methods using VR	• I was able to develop an effective learning method that can be used not only during the pandemic. • I learned what kind of learning method is necessary for the present age, and I was able to think about it by myself although the latest technology has not been done so far.	11
Improving the teaching skills in gerontic nursing practice	• I am very confident. … I think I reached the point where I can do it naturally without looking at or thinking of your guide. • I was able to teach clearly with a teaching point, and the students understood very well what the point was, which made me happy...	11
Finding a new and/or advanced theme to learn	• (The VR material was useful because) In clinical practice, high care (needing high level physical or nursing care), or especially for the terminal phase, includes patients with several comorbidities and are no longer conscious. • (The VR material included) The scene where the patient is taken care of by the family after being discharged from the hospital.	11
Understanding the necessity to provide rationales for the care process	• I have come to realize that I have not been able to properly communicate the reasons for my technique and it is so important to convey the teaching points behind teaching students. • We had no doubts to do this (assuming "this" method is the only way and is "given" without reasons), but Japanese and Indonesian members pointed out, "Why do we have to do that?" I believe that this interaction gave me the opportunity to think more deeply.	9
Exploring the way for students to think about and obtain new idea	• I believe I need to improve my own teaching skills by encouraging students to think spontaneously and interactively based on case studies, instead of just simply teaching one-sidedly from lecturer to students. • I think I was able to make the students "think" or "open their horizons," after they understood why the patient was in such a condition, and they confirmed it by themselves using VR.	9
Updating the knowledge regarding gerontic nursing	• I was able to update my knowledge of gerontic nursing by reading the textbook again and investigating why this is so. • There is a lot of information in the textbooks, but it is very difficult for me to learn concretely, so it was very useful for me to have that kind of information step by step.	8
Sharing teaching points in written documents	• I usually didn't write down the teaching points, instead, I had it only in my head. However, when I made the scenario in the project, it was important for me to share it with other teachers and review and give guidance to students. In the trial class, I was able to have a good briefing with other teachers and to do well thanks to these teaching points.	4
Making an opportunity to be evaluated by others officially	• The Department of Training and Education in my institution thanked the nurses (who attended the class) and us (nursing lectures and clinical nurse preceptors) for providing a trial class. This new VR material-based training and clinical practice will greatly contribute or help hospital certification.	4
Being a trigger to fill the gap between the clinical and academic	• I have been working in cooperation with several universities and hospitals. Therefore, I believe that we can raise the quality of education by making it a base and spreading it nationwide. • During the discussion, it was pointed out that we, who work at a hospital, and the professors of the faculty of nursing do not always have the same up-to-date information but have different views.	3

VR: virtual reality.

especially in the process of developing nursing practice materials using VR technology. Several discussions on choosing a case, making a case profile and case scenario, and revising them based on the rationale were also opportunities to form a rapport between the trainees and the project implementers. The matured relationship suggests leading to the success of the project.

Since nursing practice often encompass complex clinical judgement and technics, in nursing education, it is very important to use reality-based simulations and tools, and to have students' reflection and feedback as well (*19*). VR are rich in reality and reproducibility and can be used effectively in the learning and acquisition of nursing skills. Educators in health professional education are suggested to have specified training in the method of simulation and briefing (*20*). The current study findings, the students' questionnaire survey data and the trainees' interview data from the trial class teaching, provides one source of evidence on improving nursing education skills.

Notably, one of the results of the interview showed "Making an opportunity to be evaluated by others officially", which was not initially expected to be extracted from the interview. The evaluation from others could facilitate project management and would be a key factor in the project evaluation. A qualitative study has reported that nurses in Indonesia have been making an effort to maintain their competence through

"credentialing by a career ladder system" as well as "having hopes that managers support efforts to maintain their competence through continuing professional development" (*10*). This study indicated that a supportive environment to develop competencies such as a small honor by managers resides on the person who is willing to step-up themself was essential regardless of the credential activities.

The limitation of the study was that baseline data has been missing from this study. The comparative study could be robust for clearer evidence of the project effectiveness.

Finally, the reported project is aiming for further scale-up cooperation with PPNI and AIPNI due to the significant effects that have emerged in the process of the project. To expand and sustain the project, it is suggested that the active involvement of key stakeholders such as the PPNI and AIPNI needs to be considered.

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References

1. World Health Organization. The global health observatory. *https://www.who.int/data/gho* (accessed March 10, 2023).
2. World Health Organization. State of the world's nursing 2020: investing in education, jobs and leadership. *https://www.who.int/publications/i/item/9789240003279* (accessed March 10, 2023).
3. Badan Pusat Statistik (BPS - Statistics Indonesia). Welfare statistics 2019. *https://www.bps.go.id/publication/2019/11/22/1dfd4ad6cb598cd011b500f7/statistik-kesejahteraan-rakyat-2019.html* (accessed March 10, 2023).
4. Directorate General of Higher Education, Ministry of Education and Culture, Republic of Indonesia. Indonesian qualification framework (*Kerangka Kualifikasi Nasional Indonesia*): Presidential Decree No. 8/2012: Implication and implementation strategies. *http://kkni.ristekdikti.go.id/asset/pdf/iqf_booklet_(english).pdf* (accessed March 10, 2023).
5. Huston CL, Phillips B, Jeffries P, Todero C, Rich J, Knecht P, Sommer S, Lewis MP. The academic-practice gap: Strategies for an enduring problem. Nurs Forum. 2018; 53:27-34.
6. Hatlevik IK. The theory-practice relationship: Reflective skills and theoretical knowledge as key factors in bridging the gap between theory and practice in initial nursing education. J Adv Nurs. 2012; 68:868-877.
7. Scully NJ. The theory-practice gap and skill acquisition: An issue for nursing education. Collegian. 2011; 18:93-98.
8. Corlett J. The perceptions of nurse teachers, student nurses and preceptors of the theory-practice gap in nurse education. Nurse Educ Today. 2000; 20:499-505.
9. Burau of international health cooperation, national center for global health and medicine. Report on the Projects for Global Extension of Medical Technologies (TENKAI Project) 2021. *http://kyokuhp.ncgm.go.jp/activity/open/R2pdf/2020_32_i15n.pdf* (accessed March 10, 2023). (in Japanese)
10. Rahmah NM, Hariyati TS, Sahar J. Nurses' efforts to maintain competence: A qualitative study. J Public Health Res. 2021; 11:2736.
11. Holdsworth C, Skinner EH, Delany CM. Using simulation pedagogy to teach clinical education skills: A randomized trial. Physiother Theory Pract. 2016; 32:284-295.
12. Rossi PH, Lipsey MW, Henry GT. Chapter 1 What is program evaluation and why is it needed? In: evaluation a systematic approach eighth edition. Sage publications, CA, USA. 2019: 6-28.
13. IPEGERI (Ikatan Perawat Gerontik Indonesia). *https://ipegeri.org/* (accessed March 10, 2023).
14. Saunders RP. Implementation monitoring and process evaluation. Sage publications, CA, USA. 2016.
15. Knoll T, Neri M. Designs for mixed methods research. In: mixed methods research for nursing and the health science (Andrew S, Halcomb, eds.). Willey-black well, Oxford, UK. 2009: 31-49.
16. The Kirkpatrick model. Kirkpatrick partners, LLC. *https://www.kirkpatrickpartners.com/the-kirkpatrick-model/* (accessed March 10, 2023).
17. Krippendorff K. Content analysis: An introduction to its methodology. Sage publications, CA, USA. 2018.
18. VERBI software gmbH. MAXQDA2022. *https://www.maxqda.com/* (accessed March 10, 2023).
19. Solheim E, Plathe H S, Eide H. Nursing students' evaluation of a new feedback and reflection tool for use in high-fidelity simulation - Formative assessment of clinical skills. A descriptive quantitative research design. Nurs Educ Pract. 2017; 27:114-120.
20. Nyoni CN, van der Merwe A, Botha BS, Fourie C, Botma Y, Labuschagne MJ, van Wyk R. Health sciences educator's simulation debriefing practice needs: A mixed methods study. J Educ Health Promot. 2023; 12:55.

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BRIEF REPORT
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An age-stratified cross-sectional study of antidiabetic and non-antidiabetic drugs prescribed to Japanese outpatients with diabetes

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Abstract: Polypharmacy, common in patients with diabetes, may cause adverse drug reactions. The number of antidiabetic and non-antidiabetic drugs prescribed to patients in different age groups remains unclear. The aim of this study was to examine the number and class of antidiabetics and non-antidiabetics prescribed to Japanese patients with diabetes, stratified by age for reducing polypharmacy. This cross-sectional study examined all prescriptions of patients prescribed antidiabetics at 257 pharmacies of Matsumotokiyoshi Holdings in Japan from May 2018 to March 2019. Total prescription numbers including antidiabetic drugs were 263,915 in this study. Mean numbers of antidiabetic drugs per prescription were 1.71, 2.17, and 1.52 in the patient age groups of 10–19, 50–59, and 90–99 years, respectively. Count of antidiabetics was not related to age. However, the mean total number of drugs prescribed increased with age, which was 2.22 and 7.99 in the age groups of 10–19 and 90–99 years, respectively. The linear regression coefficient (b) according to age was 0.07 ($p < 0.001$) for 10–99 years. The mean non-antidiabetic number of agents prescribed increased with age among 10–99 years (b = 0.07, $p < 0.001$). Among outpatients treated for diabetes, dipeptidyl peptidase-4 inhibitors (29%) and antihypertensive, β-blocking and renin-angiotensin system blocking drugs (32%) were the most prescribed antidiabetics and non-antidiabetics in all ages, respectively. The number of prescribed antidiabetic agents did not increase with age, whereas the total and non-antidiabetic numbers of medications prescribed increased linearly. For reduction of polypharmacy in older people with diabetes, we need to focus on non-antidiabetics.

***Keywords*:** polypharmacy, diabetes, age-stratified, antidiabetic agents, non-antidiabetic drugs, prescriptions

Introduction

The rate of multimorbidity, whereby patients are affected by multiple chronic illnesses, is increasing in ageing populations (*1*). Older adults with multimorbidity often receive multiple prescriptions. Polypharmacy is defined as the concurrent use of multiple drugs (*2,3*). Polypharmacy enhances clinical benefits while minimising risks, providing treatments that are well-managed (*4*), however, it may increase the risk of adverse drug reactions (ADRs) (*5,6*). Indeed, a growing body of evidence suggests that polypharmacy increases a range of risks, including those of ADRs (*7-9*). Kojima *et al*. reported that outpatients taking five or more drugs are at an increased risk of falling; moreover, inpatients aged ≥ 65 years taking six or more drugs are at an increased risk of ADRs (*10,11*).

Masnoon *et al.* (*12*) reported that in 80.4% of definitions, polypharmacy is defined by the numerical values of daily medications, whereas 10.9% of definitions also consider treatment duration and setting. Although a definitive definition of polypharmacy remains to be established, it commonly refers to the routine use of five or more drugs (*3,12*).

Diabetes is associated with an increased risk of microangiopathy, atherosclerotic diseases, dyslipidaemia, hypertension, and obesity, among others. Patients with diabetes tend to have higher incidence rates of polypharmacy (*8*) than non-diabetics, even when antihyperglycemic drugs are excluded (*2*). Older patients with diabetes are more likely than their younger counterparts to receive polypharmacy (*13-15*). The overall number of drugs prescribed tends to be higher for older patients with diabetes than for their younger counterparts. However, the number and class of antidiabetic and non-antidiabetic drugs prescribed to each age group remain unclear. Understanding the types and counts of drugs that are concurrently prescribed to

patients with diabetes may help reduce inappropriate polypharmacy.

The aim of this study was to examine the number and class of antidiabetic and non-antidiabetic agents prescribed to patients aged 10–99 years, stratified by age (10-year age range) for decreasing polypharmacy. The study used a database of prescriptions handled by dispensing pharmacies of Matsumotokiyoshi Holdings for 1 year.

Materials and Methods

Study design and data source

This cross-sectional observational study was performed using the database of prescriptions dispensed to patients at 257 pharmacies of Matsumotokiyoshi Holdings from 1 April 2018 to 31 March 2019. These pharmacies were mainly located in Honshu where 81% of Japan's population lives. Employees from the participating pharmacy anonymised the prescriptions, and subsequently extracted prescription data, including information on patient age, sex, and medication type and count. Data extraction was approved by the operating officer of Matsumotokiyoshi Holdings. The total prescription count was 3,780,193, of which 263,915 included antidiabetic agents.

The study protocol was approved by the Ethics Committee of Chiba University (No. 206), and it adhered to the tenets of the Declaration of Helsinki. Informed consent was not required because the data were anonymised.

Polypharmacy

We defined polypharmacy as a prescription of five or more drugs with no consideration of treatment duration. Only prescription drugs were included; over-the-counter drugs, complementary medicines, and supplements were excluded.

Data collection

Prescriptions of patients who had been prescribed at least one antidiabetic drug were stratified by age (10-year age range). Drug class and count were assessed per age group. We counted numbers of prescribed drugs per prescription without consideration of dosage and directions of medicine. In other words, if there were 2 tablets of metformin (250 mg) 3 times a day in a prescription, the prescribed drug was counted as one. Antidiabetic agents were classified as dipeptidyl peptidase-4 inhibitors (DDP-4i), biguanides, insulins, sulfonylureas, sodium glucose cotransporter-2 inhibitors (SGLT-2i), α-glucosidase inhibitors (αGI), thiazolidine derivatives (TZD), glinides, glucagon-like peptide-1 (GLP-1) receptor agonists, and combination drugs. The Anatomical Therapeutic Chemical Classification System (ATC) classification (*16*) of these agents is shown in Supplemental Table S1 (*https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=70*). "Combination drugs" were defined as those that included two different drug classes from this list.

Non-antidiabetic agents were classified as antihypertensive, β-blocking and renin-angiotensin (RA) system blocking, lipid-modifying, alimentary tract, antithrombotic, psychotropic drugs, and others. ATC codes of antihypertensive, β-blocking and RA system blocking agents were C02, C03, C07, C08, C09, and G04CA03, which were mainly used for hypertension and chronic heart failure in Japan. Lipid-modifying drugs were included in ATC group C10, except for C10BX03. Alimentary tract medications were included in ATC group A, except for A10A and A10B. Antithrombotic agents were included in ATC groups B01A and C10AX06. Psychotropic drugs were coded N05, N06, and C02AC02 (Supplemental Table S2, *https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=70*). "Others" drugs included all other ATC codes in non-antidiabetic agents. Twelve agents without ATC codes were classified based on drug efficacy (Supplemental Table S3, *https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=70*).

Outcome

The outcomes of interest were the class and count of drugs prescribed to patients with diabetes included in the pharmacy database, stratified by age (10-year age range).

Statistical analysis

The prevalence of polypharmacy and drug class and count were compared among age groups (10-year age ranges) in the complete dataset. The count of drugs per prescription was described as mean ± standard deviation in each age range. We also expressed the count of antidiabetic or non-antidiabetic drugs prescribed as the mean number and the proportion compared to the total number of agents in each age range. The linear regression of mean number of drugs prescribed by age was analysed. The independent variable was midpoint of age range and the dependent variable was mean number of drugs calculated for each class. The slope of the regression line (b) was estimated and the p value was calculated in testing of the null hypothesis that the population linear coefficient was zero. The p value was significant below 0.05. Sex stratification was omitted owing to insignificant differences between prescriptions for males and females. The number of prescriptions in the age groups of 0–9 years and 100–109 years was 179 and 36, respectively, with the overall prescription rate below 0.1%; therefore, we excluded these data from the

study. Statistical Analysis System (SAS) software version 9.4 was used for the statistical analysis.

Results and Discussion

Prevalence of polypharmacy

The total number of prescriptions for patients taking at least one antidiabetic drug increased with age from 0–79 years and then decreased in patients of ≥ 80 years. The highest number of prescriptions was 73,431 in the age group of 70–79 years (Table 1). The overall rate of polypharmacy was 57.5%, of which 45.3% was 5-9 drugs and 12.2% was ≥ 10 drugs, and it increased with age. Older patients were more likely than younger patients to receive 10 or more drugs (Table 1).

The rate of polypharmacy in patients with diabetes had a strong relationship with age (Table 1); this is consistent with the results of previous studies (*7,13,15*). The class and count of drugs prescribed remain unclear and should be examined in age-stratified analysis to support policies aimed at reducing instances of inappropriate polypharmacy.

Mean drug count of prescriptions including antidiabetic agents

The overall mean counts of drugs per prescription were 2.22 and 7.99 in individuals aged 10–19 and 90–99, respectively (Table 2). The number of drugs prescribed linearly increased with patients' age between 10–99 years (Figure 1). The linear regression coefficient (b) was 0.07 ($p < 0.001$). The mean count of non-antidiabetic agents prescribed also increased with patient age from 10–99 years (b = 0.07, $p < 0.001$) (Table 2). However, the relationship of antidiabetic drugs with age differed. Comparing patients aged 10–19, 50–59 and 90-99 years, the mean count of antidiabetic prescriptions was 1.71, 2.17 and 1.52, respectively, and the prescription count did not increase linearly with age (b = -0.002, p = 0.489). The maximum mean count of antidiabetic agents was observed in the 50–59-year-old patients (2.17), decreasing to patients aged 90–99 years (Table 2).

A multicenter cross-sectional survey in Italy (METABOLIC Study) showed that 49.6% of diabetic patients were treated with only one oral antidiabetic drug and 12.5% were treated with three or more, indicating

Table 1. Age-stratified prevalence of polypharmacy on prescriptions including antidiabetic agents

Age (years)	Numbers of all drugs prescribed				*n*
	1–4	≥ 5	5-9	≥ 10	
All ages	42.5(%)	57.5 (%)	45.3 (%)	12.2 (%)	263,915
10–19	92.0	8.0	7.9	0.1	736
20–29	86.0	14.0	12.3	1.6	1,980
30–39	74.6	25.4	21.7	3.7	8,430
40–49	58.1	41.9	36.0	5.9	26,442
50–59	49.2	50.8	42.4	8.4	44,385
60–69	41.5	58.5	47.5	11.1	72,268
70–79	29.5	70.5	51.9	18.6	73,431
80–89	20.0	80.0	55.3	24.7	33,324
90–99	17.9	82.1	49.5	32.6	2,704

Numbers show the proportion of prescriptions in each age range/total number of prescriptions in corresponding age range. *n* indicates the total number of prescriptions including antidiabetic agents.

Table 2. Mean drug count of prescriptions including antidiabetic agents by age

Age (years)	Count of antidiabetics prescribed	Count of non-antidiabetics prescribed	Overall count of drugs prescribed	*n*
All ages	1.99 ± 1.05	3.67 ± 3.18	5.60 ± 3.25	263,915
10–19	1.71 ± 0.81	0.60 ± 1.19	2.22 ± 1.33	736
20–29	1.88 ± 0.96	0.82 ± 1.37	2.73 ± 2.01	1,980
30–39	1.96 ± 1.03	1.62 ± 2.52	3.51 ± 2.76	8,430
40–49	2.13 ± 1.14	2.31 ± 2.56	4.51 ± 2.84	26,442
50–59	2.17 ± 1.14	2.96 ± 2.87	5.12 ± 3.04	44,385
60–69	2.07 ± 1.10	3.40 ± 2.93	5.44 ± 3.05	72,268
70–79	1.92 ± 0.99	4.10 ± 3.16	6.07 ± 3.27	73,431
80–89	1.77 ± 0.89	5.23 ± 3.40	7.02 ± 3.40	33,324
90–99	1.52 ± 0.76	6.46 ± 3.50	7.99 ± 3.62	2,704
Linear regression coefficients				
b	-0.002	0.07	0.07	
p	0.489	< 0.001	< 0.001	

Count of drugs per prescription is shown as means ± standard deviation in each age range. Overall count of drugs prescribed indicates the number of all drugs including antidiabetic and non-antidiabetic ones per prescription. *n* indicates the total number of prescriptions including antidiabetic agents. Linear regression coefficient (b) is calculated between the mean number of drugs and midpoint of age range.

that the mean count of antidiabetics was approximately 1.7 per person over 65 years old (*14*). There was another report about antidiabetic drug prescription from National Center Diabetes Database in Japan. It stated that only one antidiabetic agent was prescribed in about 30% of diabetic patients, two antidiabetics were used in about 30% of patients, and three or more antidiabetics were used in about 40% below the 65 years age group, suggesting that the mean number of antidiabetics prescribed was about 2.2 per person in this report (*17*). Mean drug count of antidiabetics per prescription was 1.99 in all ages of our study, which is almost consistent with the data of these papers.

The reasons for the different patterns observed between antidiabetic and overall drug use in association with age remains unclear. Combination drugs are not the reason because its use did not increase with age among patients aged 50–99 years (Table 3). However, international guidelines on diabetes management recommend different haemoglobin A1c (HbA1c) values, depending on patient age (*18-20*). Blood glucose and HbA1c levels may differ depending on disease management and complications in older patients with diabetes. Strict blood glucose control may not reduce the risk of cardiovascular disease-related death in older adults with diabetes (*21*), consequently, the recommended HbA1c levels of patients with complications are higher in older patients than in younger counterparts. Furthermore, the prevalence of diabetes increases rapidly in people over 50 years old age. Blood glucose levels in aged patients newly diagnosed might not be higher than those in younger patients. These things might be related to the discrepancies in the associations of the antidiabetics and overall prescription drugs with age.

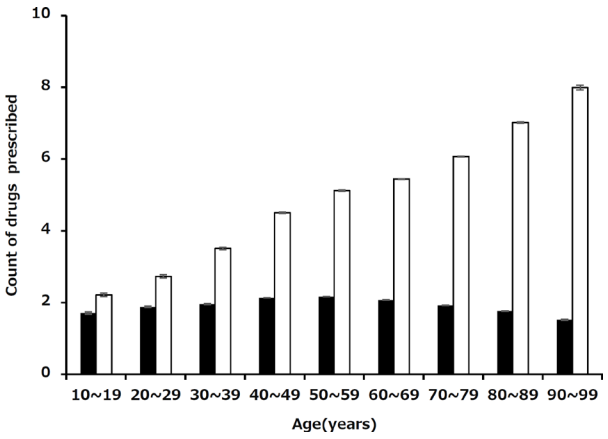

Figure 1. Mean drug count of antidiabetic and overall prescription drugs by age. The number of prescribed drugs is expressed as mean ± standard error. Mean drug count of antidiabetics is shown as closed column, and that of overall agents prescribed is as open column.

Classification and count of antidiabetic prescriptions

Table 3 shows the age-stratified proportions of antidiabetic agent use. In all age groups, DDP-4i (29.2%) was the most used agent, followed by biguanides (16.8%), insulins (12.5%), sulfonylureas (10.8%), SGLT-2i (9.0%), and αGI (7.3%). Insulin prescription rates were 69.9% and 39.2% in the 10–19 and 20–29 years age groups, respectively, which were most frequently prescribed in these age groups. The rates of biguanide use were 25.3% and 21.4%, highest among prescribed drugs in the age groups of 30–39 and 40–49 years, respectively. The DDP-4i prescription rates were 5.5% and 51.8% in the 10–19 and 90–99 years age groups, respectively. This was the most prescribed drug in patients aged 50–99 years. TZD, glinides, and GLP-1 receptor agonists accounted for < 5% of antidiabetic drugs. Combination drugs were used at 8.1% in the 50–59 years age group,

Table 3. Classification and proportion of count of antidiabetic and non-antidiabetic drugs in prescriptions by age

Age (years)	All ages	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
Antidiabetics										
DPP-4i (%)	29.2	5.5	9.7	14.4	19.9	23.5	28.6	34.6	41.0	51.8
Biguanides (%)	16.8	12.2	23.2	25.3	21.4	20.0	18.5	13.5	9.0	5.1
Insulins (%)	12.5	69.9	39.2	24.7	15.2	11.9	11.3	11.3	10.2	7.8
Sulfonylureas (%)	10.8	0.5	2.0	4.3	6.4	9.1	11.0	13.0	14.3	14.1
SGLT-2i (%)	9.0	2.9	12.0	14.2	16.4	13.8	8.9	5.0	2.8	1.9
αGl (%)	7.3	3.9	4.8	4.2	5.0	6.1	7.2	8.6	9.2	9.2
TZD (%)	3.2	1.1	1.5	2.1	3.1	3.0	3.3	3.2	3.7	2.2
Glinides (%)	2.7	0.6	1.5	1.2	1.9	2.2	2.6	3.2	4.0	4.4
GLP-1 receptor agonists (%)	1.8	1.9	2.6	2.9	2.9	2.4	1.5	1.3	1.5	0.9
Combination drugs (%)	6.8	1.5	3.6	6.7	7.8	8.1	7.1	6.3	4.4	2.7
Non-antidiabetics										
Antihypertensive, β-blocking and RA system blocking agents (%)	32.0	5.1	17.1	23.4	31.2	33.9	35.1	32.4	28.8	24.6
Lipid modifying agents (%)	17.1	5.9	19.8	21.7	23.5	22.5	20.3	16.5	10.9	5.7
Alimentary tract agents (%)	16.9	21.6	17.7	13.6	13.7	13.1	14.7	17.3	21.2	22.1
Antithrombotic agents (%)	9.3	0.0	0.1	2.1	4.1	6.6	9.4	10.7	10.6	9.1
Psychotropic agents (%)	6.1	3.4	3.7	7.2	3.8	4.6	4.6	6.7	7.9	8.7
Others (%)	18.7	64.0	41.7	32.0	23.7	19.4	15.9	16.3	20.6	29.8

Numbers show the proportion of each drug number in age range/total number of diabetic or non-antidiabetic agents in the corresponding age range.

which was decreasing in patients aged 90–99 years (2.7%). The count of DDP-4i prescribed increased linearly with patient age from 10–99 years (b = 0.009, $p < 0.001$) (Table 4). Biguanides and SGLT-2i were the most prescribed agents in the age groups of 30–39 and 40–49 years, respectively, compared to other age ranges; older patients were less likely to receive these drugs. Insulin use rates were inversely related to age from 10–99 years (b = -0.011, $p = 0.003$). Sulfonylurea and αGI use positively related to age, yielding linear regression coefficients of 0.003, $p < 0.001$ and 0.002, $p < 0.001$, respectively in both cases (Table 4).

A consensus statement from the Japan Diabetes Society (JDS) is based on the concept of the differences in diabetes pathology and pharmacotherapy between Japan, Asians, and Westerners (*22*). DDP-4i has the lowest ADR risk and effectively reduces HbA1c levels in Asian patients but not in non-Asian populations (*23*). These drug properties may account for the popularity of DDP-4i among older adults with diabetes in Japan. In fact, Bouchi *et al.* (*24*) reported that DDP-4i accounts for > 60% of first prescriptions among patients with diabetes included in the National Database of Health Insurance Claims and Specific Health Check-ups of Japan. The estimates of DPP-4i use in Japanese patients reported by Bouchi *et al.* (*24*) differ from those in this study. This is likely because different target populations were studied. For instance, Bouchi *et al.* (*24*) analysed newly introduced antidiabetic medications only but we analysed total prescribed antidiabetic drugs in this study. Additionally, our calculations included insulin and combination drugs administered through both oral and other routes, whereas Bouchi *et al.* (*24*) restricted the analysis to oral antidiabetics except injectable formulations of GLP-1 receptor agonists.

The decline in biguanide use in individuals aged 30–99 years may be associated with the contraindications of renal insufficiency (estimated glomerular filtration rate of < 30 mL/min), severe heart failure, and severe liver damage (*18*), which increase with age. Insulin is universally prescribed for patients with type 1 diabetes, which has an incidence rate of 2.3/100,000 children in Japan (*25*), this incidence is comparable to patients aged 0–60 years (*26*). The incidence of type 2 diabetes is 3.0/100,000 children (*27*), whereas the number increases rapidly among patients aged ≥ 20 years. Therefore, the ratio of patients with type 1/type 2 diabetes is higher among younger people than among older people in Japan, likely accounting for the high frequency of insulin use among patients aged 10–29 years.

Japanese guidelines on diabetes management in older patients state that insulin and sulfonylurea should be used with caution in cases associated with multiple complications (*18*). Sulfonylureas were prescribed to > 10% of patients aged 60–99 years in our study. Future studies are required to evaluate the safety and efficacy profiles of this approach. SGLT-2i may reduce the risks of heart failure and chronic kidney disease; herein, the associated prescription rate was 9.0% overall. SGLT-2i has been previously reported as first-line treatment in 7.6% of patients (*24*). This rate will likely increase in Japan in the future.

Classification and count of non-antidiabetic prescriptions

Table 3 shows the age-stratified proportions of non-antidiabetic drugs prescribed. The proportion of antihypertensive, β-blocking and RA system blocking agents was 32.0%, the most prescribed group of non-antidiabetic medications in all age groups. Overall, five

Table 4. Classification and count of antidiabetic and non-antidiabetic drugs in prescriptions by age

Age (years)	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99	b	*p*
Antidiabetics											
DPP-4i	0.10	0.18	0.29	0.43	0.51	0.59	0.66	0.72	0.80	0.009	< 0.001
Biguanides	0.21	0.44	0.50	0.46	0.44	0.38	0.26	0.16	0.08	-0.003	0.102
Insulins	1.22	0.74	0.49	0.33	0.26	0.23	0.22	0.18	0.12	-0.011	0.003
Sulfonylureas	0.01	0.04	0.09	0.14	0.20	0.23	0.25	0.25	0.22	0.003	< 0.001
SGLT-2i	0.05	0.23	0.28	0.36	0.30	0.19	0.10	0.05	0.03	-0.002	0.254
αGl	0.07	0.09	0.08	0.11	0.13	0.15	0.17	0.16	0.14	0.002	< 0.001
TZD	0.02	0.03	0.04	0.07	0.07	0.07	0.06	0.07	0.03	0.000	0.239
Glinides	0.01	0.03	0.02	0.04	0.05	0.05	0.06	0.07	0.07	0.001	< 0.001
GLP-1 receptor agonists	0.03	0.05	0.06	0.06	0.05	0.03	0.03	0.03	0.01	0.000	0.075
Combination drugs	0.03	0.07	0.13	0.17	0.18	0.15	0.12	0.08	0.04	0.000	0.950
Non-antidiabetics											
Antihypertensive, β-blocking and RA system blocking agents	0.03	0.12	0.33	0.62	0.82	0.97	1.06	1.29	1.54	0.019	< 0.001
Lipid modifying agents	0.03	0.15	0.31	0.47	0.55	0.56	0.54	0.49	0.36	0.005	0.036
Alimentary tract agents	0.11	0.13	0.19	0.27	0.32	0.40	0.57	0.95	1.39	0.014	0.001
Antithrombotic agents	0.00	0.00	0.03	0.08	0.16	0.26	0.35	0.48	0.57	0.008	< 0.001
Psychotropic agents	0.02	0.03	0.10	0.08	0.11	0.13	0.22	0.36	0.54	0.006	0.001
Others	0.32	0.30	0.45	0.47	0.47	0.44	0.54	0.93	1.87	0.014	0.019

Numbers present the mean count of each drug per prescription in age range. Linear regression coefficient (b) is calculated between midpoint of age range and the mean count of each drug.

groups which were antihypertensive, β-blocking and RA system blocking, lipid-modifying, alimentary tract, antithrombotic, and psychotropic agents accounted for 81.3% of non-antidiabetic drugs. In patients aged 10–39 and 90–99 years, 'others' in non-antidiabetic medications, excluding these five most prescribed ones, were the most highly prescribed. However, in patients aged 40–89 years, antihypertensive, β-blocking and RA system blocking agents were the most highly prescribed medications. Lipid-modifying drugs were prescribed most commonly in 40–49-year-olds compared to other age ranges.

The counts of these five frequently used drugs except lipid modifying ones increased with patient age (Table 4). The number of antihypertensive, β-blocking and RA system blocking drugs, and antithrombotic drugs showed strong relation to age ($b = 0.019$, $p < 0.001$; and $b = 0.008$, $p < 0.001$, respectively) (Table 4).

The counts of antihypertensive, β-blocking and RA system blocking agents, and antithrombotic agents increase with age, likely owing to the increases in the occurrence of vascular complications associated with diabetes. The proportion of lipid-modifying agent use decreased in patients aged ≥ 40 years. O'Keeffe *et al.* (*28*) reported slight HbA1c level increases and low-density lipoprotein cholesterol (LDL-C) decreases in women aged 53–69 years in the United Kingdom, suggesting that glucose and LDL-C do not respond synergistically. The relationship between HbA1c and LDL-C levels and age should be elucidated. The use of psychotropic medicines, especially benzodiazepines, is known to increase with age (*29*), these findings are consistent with those of this study. The most prescribed drugs in the age group of 10–39 years were in the category "others". The composition of this category remains unclear and should be evaluated.

Our data on the different patterns between antidiabetic and non-antidiabetic drug use with age, suggests that antidiabetic agents are not targets for reduction of polypharmacy in older people with diabetes. As for non-antidiabetic drugs, those excluding lipid-modifying agents increased with patient age. From these results alone, it is hard to determine which class of drugs we need to focus on for reducing inappropriate polypharmacy. Generally, the increase of prescribed drugs is closely related with the potentially inappropriate medication (PIM) (*15*). Large parts of PIM are benzodiazepines in psychotropic drugs and H_2-receptor antagonists in alimentary tract agents seen in a survey in Japan (*30*). Our data demonstrated that the prescription of alimentary tract and psychotropic medications increased with patient age. Therefore, we think that it is important to be careful using benzodiazepines and H_2-receptor antagonists to reduce inappropriate polypharmacy closely related with PIM.

This study had some limitations. First, we only examined patients with diabetes who were taking antidiabetic drugs; thus, rates of polypharmacy in patients with diabetes who were not taking such drugs remain unclear. Second, patient clinical signs and symptoms were not evaluated in this study; therefore, the rates of suitable and unsuitable polypharmacy remain unclear. Third, we could not distinguish between type 1 and type 2 diabetes mellitus. It is important to recognise diabetic types because the treatments and causes of the diseases differ. Fourth, it is possible that a patient visited two or more departments in different hospitals to treat complications and received several prescriptions dispensed from different pharmacies. In these cases, the accurate number of non-antidiabetic drugs would be higher than that determined in our study. Finally, as our study was observational, the true causes of different patterns of antidiabetic and non-antidiabetic drug use associated with age could not be determined.

In conclusion, among Japanese patients with diabetes, the mean overall and non-antidiabetic number of drugs per prescription increased with age. However, the count of antidiabetic drugs did not relate to age and the highest number of these prescriptions was observed in the age group of 50–59 years, suggesting that antidiabetic drugs are not targets for reducing inappropriate polypharmacy in older people with diabetes. We need to aim non-antidiabetic agents with PIM. DDP-4i, and antihypertensive, β-blocking and RA system blocking drugs were the most prescribed antidiabetic and non-antidiabetic agents in the studied patients, respectively.

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References

1. Navickas R, Petric VK, Feigl AB, Seychell M. Multimorbidity: What do we know? What should we do? J Comorb. 2016; 6:4-11.
2. Huang YT, Steptoe A, Wei L, Zaninottob P. Polypharmacy difference between older people with and without diabetes: Evidence from the English longitudinal study of ageing. Diabetes Res Clin Pract. 2021; 176:108842.
3. World Health Organization. Medication safety in polypharmacy: technical report, 2019 *https://www.who.int/publications/i/item/WHO-UHC-SDS-2019.11* (accessed March 18, 2022).
4. Cadogan CA, Ryan C, Francis JJ, Gormley GJ, Passmore

P, Kerse N, Hughes CM. Development of an intervention to improve appropriate polypharmacy in older people in primary care using a theory-based method. BMC Health Serv Res. 2016; 16:661.
5. Arai S, Ishikawa T, Kato H, Koshizaka M, Maezawa Y, Nakamura T, Suzuki T, Yokote K, Ishii I. Multidrug use positively correlates with high-risk prescriptions in the Japanese elderly: A longitudinal study. J Pharm Health Care Sci. 2019; 5:20.
6. Guthrie B, Makubate B, Hernandez-Santiago V, Dreischulte T. The rising tide of polypharmacy and drug-drug interactions: Population database analysis 1995–2010. BMC Med. 2015; 13:74.
7. Höhn A, Jeyam A, Caparrotta TM, *et al*. The association of polypharmacy and high-risk drug classes with adverse health outcomes in the Scottish population with type 1 diabetes. Diabetologia. 2021; 64:1309-1319.
8. Dobrică EC, Găman MA, Cozma MA, Bratu OG, Stoian AP, Diaconu CC. Polypharmacy in type 2 diabetes mellitus: Insights from an internal medicine department. Medicina (Kaunas). 2019; 55:436.
9. Al-Musawe L, Torre C, Guerreiro JP, Rodrigues AT, Raposo JF, Mota-Filipe H, Martins AP. Polypharmacy, potentially serious clinically relevant drug-drug interactions, and inappropriate medicines in elderly people with type 2 diabetes and their impact on quality of life. Pharmacol Res Perspect. 2020; 8:e00621.
10. Kojima T, Akishita M, Nakamura T, Nomura K, Ogawa S, Iijima K, Eto M, Ouchi Y. Polypharmacy as a risk for fall occurrence in geriatric outpatients. Geriatr Gerontol Int. 2012; 12:425-430.
11. Kojima T, Akishita M, Kameyama Y, Yamaguchi K, Yamamoto H, Eto M, Ouchi Y. High risk of adverse drug reactions in elderly patients taking six or more drugs: Analysis of inpatient database. Geriatr Gerontol Int. 2012; 12:761-762.
12. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr. 2017; 17:230.
13. Alwhaibi M, Balkhi B, Alhawassi TM, Alkofide H, Alduhaim N, Alabdulali R, Drweesh H, Sambamoorthi U. Polypharmacy among patients with diabetes: A cross-sectional retrospective study in a tertiary hospital in Saudi Arabia. BMJ Open. 2018; 8:e020852.
14. Noale M, Veronese N, Cavallo Perin P, Pilotto A, Tiengo A, Crepaldi G, Maggi S. Polypharmacy in elderly patients with type 2 diabetes receiving oral antidiabetic treatment. Acta Diabetol. 2016; 53:323-330.
15. Oktora MP, Alfian SD, Bos HJ, Schuiling-Veninga CCM, Taxis K, Hak E, Denig P. Trends in polypharmacy and potentially inappropriate medication (PIM) in older and middle-aged people treated for diabetes. Br J Clin Pharmacol. 2021; 87:2807-2817.
16. World Health Organization. ATC/DDD classification (temporary). WHO Drug Inf. 2019; 33:226-232.
17. Yamamoto-Honda R, Takahashi Y, Mori Y, *et al.* Changes in antidiabetic drug prescription and glycemic control trends in elderly patients with type 2 diabetes mellitus from 2005-2013: An analysis of the National Center Diabetes Database (NCDD-03). Intern Med. 2018; 57:1229-1240.
18. Araki E, Goto A, Kondo T, Noda M, Noto H, Origasa H, Osawa H, Taguchi A, Tanizawa Y, Tobe K, Yoshioka N. Japanese clinical practice guideline for diabetes 2019. J Diabetes Investig. 2020; 11:1020-1076.
19. Leung E, Wongrakpanich S, Munshi MN. Diabetes management in the elderly. Diabetes Spectr. 2018; 31:245-253.
20. LeRoith D, Biessels GJ, Braithwaite SS, Casanueva FF, Draznin B, Halter JB, Hirsch IB, McDonnell ME, Molitch ME, Murad MH, Sinclair AJ. Treatment of diabetes in older adults: An Endocrine Society* clinical practice guideline. J Clin Endocrinol Metab. 2019; 104:1520-1574.
21. Action to Control Cardiovascular Risk in Diabetes Study Group; Gerstein HC, Miller ME, *et al.* Effects of intensive glucose lowering in type 2 diabetes. N Engl J Med. 2008; 358:2545-2559.
22. Bouchi R, Kondo T, Ohta Y, Goto A, Tanaka D, Satoh H, Yabe D, Nishimura R, Harada N, Kamiya H, Suzuki R, Yamauchi T. A consensus statement from the Japan Diabetes Society (JDS): a proposed algorithm for pharmacotherapy in people with type 2 diabetes. Diabetol Int. 2023; 14:1-14.
23. Seino Y, Kuwata H, Yabe D. Incretin-based drugs for type 2 diabetes: Focus on East Asian perspectives. J Diabetes Investig. 2016; 7(Suppl 1):102-109.
24. Bouchi R, Sugiyama T, Goto A, Imai K, Ihata-Sugiyama N, Ohsugi M, Yamauchi T, Kadowaki T, Ueki K. Retrospective nationwide study on the trends in first-line antidiabetic medication for patients with type 2 diabetes in Japan. J Diabetes Investig. 2022; 13:280-291.
25. Onda Y, Sugihara S, Ogata T, Yokoya S, Yokoyama T, Tajima N. Incidence and prevalence of childhood-onset type 1 diabetes in Japan: The T1D study. Diabet Med. 2017; 34:909-915.
26. Nishioka Y, Noda T, Okada S, Myojin T, Kubo S, Higashino T, Ishii H, Imamura T. Incidence and seasonality of type 1 diabetes: A population- based 3- year cohort study using the National Database in Japan. BMJ Open Diabetes Res Care. 2020; 8:e001262.
27. Tajima N, Morimoto A. Epidemiology of childhood diabetes mellitus in Japan. Pediatr Endocrinol Rev. 2012; 10 (Suppl 1): 44-50.
28. O'Keeffe LM, Kuh D, Fraser A, Howe LD, Lawlor D, Hardy R. Age at period cessation and trajectories of cardiovascular risk factors across mid and later life. Heart. 2020; 106:499-505.
29. Brett J, Pearson SA, Daniels B, Wylie CE, Buckley NA. A cross sectional study of psychotropic medicine use in Australia in 2018: A focus on polypharmacy. Br J Clin Pharmacol. 2021; 87:1369-1377.
30. Fujie K, Kamei R, Araki R, Hashimoto K. Prescription of potentially inappropriate medications in elderly outpatients: A survey using 2015 Japanese Guidelines. Int J Clin Pharm. 2020; 42:579-587.

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Lessons from the "Humanization of Childbirth" Projects: Qualitative analysis of seven projects funded by the Japan International Cooperation Agency

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Abstract: The "Humanization of Childbirth" Project is one of the various maternity care models that respect women and their newborn children. For more than a quarter of a century, the Japan International Cooperation Agency (JICA) has been implementing technical cooperation projects worldwide that place the humanization of childbirth at the center of the concept. By reviewing the project reports, the following 11 key processes were found for the formulation and implementation of future projects for the humanized maternity care: *i*) project-finding/exploration of unmet needs, *ii*) identification of local key persons, *iii*) organization of a project team and a back-up committee, *iv*) development of an action plan, *v*) sharing of concepts, *vi*) development of local leadership, *vii*) organization of infrastructure, *viii*) final evaluation and wrap-up seminar, *ix*) ensuring sustainability, *x*) development of younger generation experts, and *xi*) sustainable and autonomous action.

***Keywords*:** humanization of childbirth, respectful care, maternity care, childbirth, Japan International Cooperation Agency (JICA)

Introduction

The significance of person-centered and respectful maternity care is becoming widely recognized (*1*). Poor quality of care was identified as the most crucial barrier to improving maternal health and was found to be closely related to unnecessary or excessive medical interventions which undermine women's ability to give birth and impair their childbirth experience. Subsequently, the World Health Organization (WHO) undertook a strategic change of making maternity care more people-centered and created the "Quality of care framework for maternal and newborn health" in 2015 (*2,3*). Further, the WHO recommended respectful care aimed at enabling women to fulfill their potential and have positive childbirth experiences (*4*).

Concept of the humanization of childbirth

Currently, several models for maternity care have been proposed. "Humanization of childbirth" is one of these models overlapping the concept of respectful care (*5*). For more than a quarter of a century, the Government of Japan, through the Japan International Cooperation Agency (JICA), has been implementing technical cooperation projects with counterparts around the world that prioritize the humanization of childbirth. The term "dehumanization" may be able to explain the notion of "humanization" in the context of childbirth. Women giving birth are treated with disregard for their dignity in settings where they should be supported, suffer unnecessary mental and physical burdens as a result of inappropriate medical interventions that have no scientific evidence, and do not receive appropriate care when they require it. These "dehumanizing" situations take place worldwide. JICA's "humanization of childbirth" initiatives aim to make the birthplace more "humanized" by respecting the dignity and autonomy of women.

Previous projects related to the humanization of childbirth

Table 1. Target countries and projects for this study

Country	Project Title	Duration
Brazil	The Maternal and Child Health Improvement Project in North-Brazil	1996.04 – 2001.03
Bolivia	Project for Strengthening Health Network in Rural Region Focusing on Mother and Children Health in the Municipality of La Paz	2004.01 – 2005.12
	Project for Strengthening Health Network in Rural Region Focusing on Mother and Children Health in the Department of La Paz	2010.08 – 2014.08
Armenia	Reproductive Health Project	2004.12 – 2006.11
Benin	Program on Maternal and Child Health	2006 – 2016
Madagascar	Project for Improvement of Maternal, Newborn, and Child Health Service	2007.01 – 2010.01
Senegal	Project for Enforcement of Management of Health System in Tambacounda and Kedougou	2009.01 – 2011.12
	Project for Reinforcement for Maternal and New Born Health Care Phase 2	2012.11 – 2018.03
Cambodia	Project for Improving Maternal and Newborn Care through Midwifery Capacity Development	2010.03 – 2015.08

The original version of this table is presented in the report (*9*) written in Japanese and created by the authors, which has been translated into English and presented in this paper.

The first JICA-funded "Humanization of Childbirth" Project was launched in Brazil in 1996, at a time when hospital-based medicalization of childbirth was prevalent, with high cesarean section rates which were over 80% in private clinics (*6,7*). The concept of "humanization of childbirth" was brought forth by the integration of the Japanese midwifery philosophy of a "safe and satisfied birthing experience" with the Brazilian educator Paulo Freire's thoughts on "humanization", which he referred to as the "process of regaining dignity and autonomy of people who have been deprived of it". Project activities identified that humanization of childbirth includes the following aspects: fulfilling and empowering both women and their care providers, promoting the active participation and decision-making of women in all aspects of their care, providing care in which physicians and non-physicians have an equal relationship, and providing care based on scientific evidence (*8*). Since the successful introduction of this concept, JICA has implemented similar projects globally, accumulating their experiences to improve the quality of maternity care in pioneering international trends.

This study aims to describe the lessons learned from the previous JICA projects and determine the processes required for the formulation and implementation of future projects for humanized maternity care. To achieve the objectives, a qualitative study was conducted by analyzing unpublished but relevant documents, such as baseline and final evaluation reports, monthly reports, and quarterly reports of JICA projects that were completed by 2018. In addition, non-personally identifiable interview data from pregnant women, postpartum women, and key informants included in the report were also used in the analysis.

This paper is a partial work of the completion report of the "Research Project on Improving Quality of Care through the 'Humanization of Childbirth'", which was conducted under an outsourcing agreement with JICA; the full 140-page report written in Japanese is available on the JICA Web site (*9*).

Lessons from the "Humanization of Childbirth" Projects

From 1996 to 2018, nine JICA projects had been completed in seven countries, including Brazil, Bolivia, Armenia, Benin, Madagascar, Senegal, and Cambodia (Table 1). The first project was launched in 1996 in Brazil, and the most recent project was completed in 2018 in Senegal, indicating the technical cooperation of JICA of over 22 years. Based on the results of the review, 11 processes of the projects were identified and categorized into 4 phases: *i*) project-finding/exploration of unmet needs, *ii*) identification of local key persons, *iii*) organization of a project team and a back-up committee, in the "project formation" phase, *iv*) development of an action plan, *v*) sharing of concepts, *vi*) development of local leadership, *vii*) organization of infrastructure, *viii*) final evaluation and wrap-up seminar, in the "project implementation" phase, *ix*) ensuring sustainability, *x*) development of younger generation experts, in the "project follow-up" phase; and *xi*) sustainable and autonomous action, which "always needs to be noted" (Figure 1). Furthermore, promoting factors of each of the processes were extracted.

Phases of project formation

i) Project-finding/exploration of unmet needs

Typically, JICA projects begin in response to a request from partner countries. However, prior to these requests, each project had a principal person from the Japanese side who recognized the unmet needs in maternity healthcare, played an active role in the formation of the projects, and contributed to the conceptualization and development of the project design. Those principal

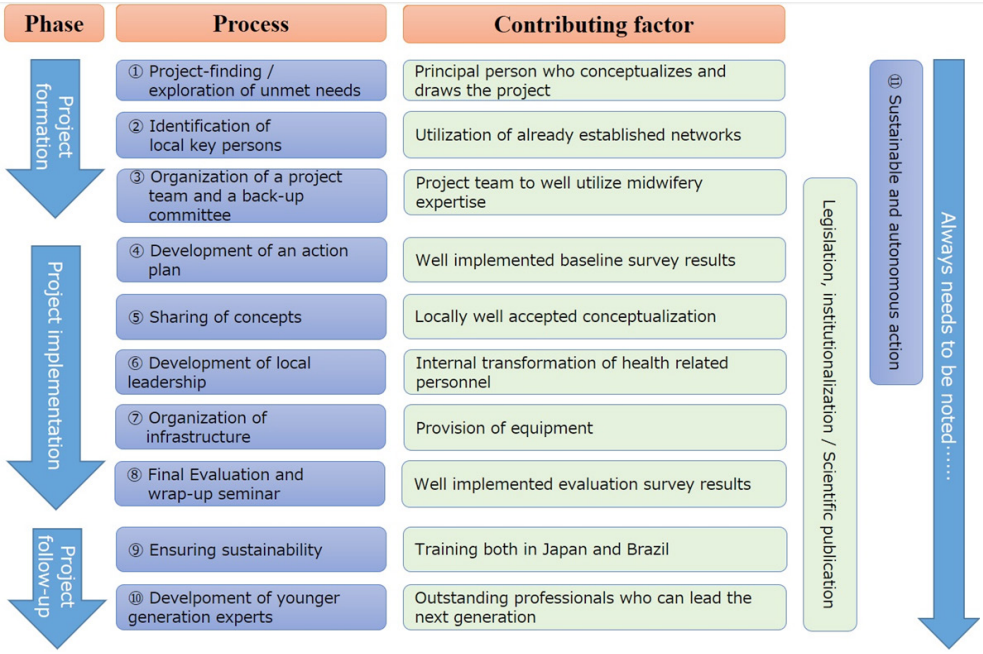

Figure 1. The processes for the formation of the project and the contributing factors. The original version of this table is presented in the report (*9*) written in Japanese and created by the authors, which has been translated into English and presented in this paper.

people included experts (as in the case of Brazil and Armenia), staff of the JICA overseas office (Bolivia), and members of the National Committee for the Project (Brazil, Cambodia, Madagascar, Senegal, and Benin).

ii) Identification of local key person

Solid and friendly partnerships had already been built in the project sites, which was critical in establishing a network of local key person. Such partnerships have been observed in places where JICA had constructed tertiary-level medical facilities (Bolivia, Cambodia, Madagascar, and Benin), where JICA had already implemented technical cooperation projects in the health sector (Cambodia), and where several midwives had been dispatched as Japan Overseas Cooperation Volunteers (JOCV) (Bolivia).

iii) Organization of a project team and a back-up committee

In projects where midwives could concentrate on their activities, they had demonstrated midwifery care in practice and could facilitate local understanding of the concept of humanization (Brazil, Cambodia, Madagascar, and Senegal). To accomplish this, a well-organized project team had to collaborate with specialists in epidemiology and/or public health who were consistently involved with planning, implementing, evaluating, and disseminating the concept of the "humanization of childbirth" throughout the project. Furthermore, the presence of a back-up committee from Japan was critical as they provided organizational support (Brazil).

Phases of project implementation

iv) Development of an action plan

The development of an action plan based on a thorough examination of the field situation at the beginning of the project was recommended. For example, appropriate action plans were derived from well-designed survey results obtained *via* the Rapid Anthropological Assessment Procedure (RAP) using anthropological methods (Brazil and Senegal).

v) Sharing of concepts

The concept of "humanization of childbirth" was shared using locally and culturally accepted terms. For example, the concept was rephrased as "Evidence-Based Medicine (EBM)" in Armenia, Madagascar, Benin, and Senegal; however, EBM itself does not encompass the entire concept of humanization. Alternatively, phrases such as "women and baby-friendly childbirth care" and "the physiological model of childbirth", were used widely.

vi) Development of local leadership

The project aimed to transfer technology and promote changes in behaviors and attitudes among the health personnel of the partner countries. Participatory workshops were useful in the realization of humanization as a sense, rather than a theory. Consequently, terms like "empowerment", "transformation", and "internal change" emerged among the care providers. At the start of these projects, such workshops were conducted by project specialists; by accumulating the experiences from the workshops, local counterparts became leaders themselves, driving the "humanization of childbirth" concept in the local context.

vii) Organization of infrastructure

Minimal environmental arrangements, such as the provision of Doppler device, installation of curtains, and introduction of balance balls to promote safety, satisfaction and comfort in women, were cost-effective approaches that were implemented in most projects. In Brazil, the JICA project supported the development of the Ministry of Health's building standards related to the "labor, delivery, and recovery (LDR) systems", which allow women to spend the entire process of their childbirth in a single room in public hospitals (*10*). Moreover, the project collaborated on the development of an LDR bed that promotes free positioning during childbirth.

viii) Final evaluation and wrap-up seminar

Conducting a survey, along with counterparts, to evaluate the impact of the project is recommended to look back at the accomplishments and identify the remaining challenges. The present study revealed that the process indicators commonly utilized for the final evaluations were easy to quantify, for example, the number of training sessions held, the number of participants, and the test scores indicating knowledge of evidence-based maternity care. However, the most crucial indicator of the childbirth experience of women was rarely evaluated. Considering the intentions of the projects to introduce the concept of humanization, indicators that appropriately capture women's childbirth experiences and care providers' internal changes are required. Additionally, a wrap-up seminar at the end of a project was found to be beneficial in summarizing project accomplishments and ensuring project sustainability after its completion. At the end of the project, Brazil hosted the first international conference about the humanization of childbirth, with approximately 2,000 participants from more than 23 countries sharing their findings and lessons learned (*11*). This conference caused the establishment of the "Latin American and Caribbean Network for the Humanization of Childbirth (RELACAHUPAN)" whose international conferences have been held regularly for the past 20 years.

Phases of project follow-up

ix) Ensuring sustainability

Efforts were made to ensure the sustainability of the humanization of childbirth after the project ended *via* training in Japan. Training at birthing homes run by midwives impressed the participants deeply with their autonomy and discipline. Since the law prohibits midwives from practicing medicine, Japanese midwives use only simple equipment, wait for the physiological processes of childbirth, and detect early deviations from the normal course of pregnancy and childbirth through continuous humanized care. Moreover, South–South cooperation in conducting training for the humanization of childbirth in Brazil has played a critical role in the sustainability of these projects. The Sofia Feldman Hospital in Brazil, in particular, is regarded as a model hospital that realizes the humanization of childbirth by providing the highest level of maternity care. Counterparts from the JICA projects globally who are in the process of introducing the concept of "humanization of childbirth" have attended the training held at this hospital.

x) Development of younger generation experts

In the early 2000s, the concepts of the humanization of childbirth were reimported to Japan from Brazil and were enthusiastically received. Since the return of the project specialists to Japan, they have been role models for the younger generation and have actively promoted human resource development. Consequently, motivated persons have been developed and play a crucial role in the implementation of successive projects (Bolivia, Armenia, Benin, Madagascar, Senegal, and Cambodia).

Always needs to be noted

xi) Sustainable and autonomous action

Looking ahead to the end of the projects, project experts are always required to take note of sustainable and autonomous actions. For example, the establishment of an educational system for obstetric and neonatal nurses, as well as that of regulations to guarantee the humanization of childbirth as a fundamental human right, were found to be effective. In addition, the publication of academic papers on this topic provided opportunities to share knowledge and expand networks.

Conclusion and suggestions

This study reviewed a quarter-century of experience of JICA in projects for the humanization of childbirth, extracting lessons learned from 9 projects in 7 countries and describing 11 necessary processes divided into 4 phases. Building partnerships between project members and their counterparts in host countries was found to be fundamental throughout the projects, as described in each process.

The current global goal of maternal and child health is to lower the maternity mortality ratio (MMR). In contrast, MMR may only represent severe cases that require emergency care. The reduction of maternal deaths is not, in itself, the same as improving maternity care. The WHO Quality of Care Framework may have been developed in an attempt to capture the care provided and the childbirth experiences of women (*3*); unfortunately, this framework did not exist when the target projects in this study began. As mentioned in the 8th process, indicators that appropriately capture women's childbirth experiences and care providers' internal changes are required.

This study had several limitations. First, this study did not go into detail about the activities, interventions, and outcomes of the projects in the seven countries. Second, obstructive factors, such as a lack of funds and human resources, were not described because majority of the obstructive factors could not be solved through project intervention. Finally, this study could not include information on the current situation at the project sites. However, we believe that this study has been able to compile a list of points to consider when implementing projects related to the humanization of childbirth.

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References

1. World Health Organization. The prevention and elimination of disrespect and abuse during facility-based childbirth. 2015. *https://apps.who.int/iris/bitstream/handle/10665/134588/WHO_RHR_14.23_eng.pdf* (accessed May 1, 2023).
2. Tunçalp Ö, Were WM, MacLennan C, Oladapo OT, Gülmezoglu AM, Bahl R, Daelmans B, Mathai M, Say L, Kristensen F, Temmerman M, Bustreo F. Quality of care for pregnant women and newborns-the WHO vision. BJOG. 2015; 122:1045-1049.
3. World Health Organization: Standards for improving quality of maternal and newborn care in health facilities. 2016. *https://www.who.int/publications/i/item/9789241511216* (accessed May 1, 2023).
4. World Health Organization: WHO recommendations: Intrapartum care for a positive childbirth experience. 2018. *https://www.who.int/publications/i/item/9789241550215* (accessed May 1, 2023).
5. Curtin M, Savage E, Leahy-Warren P. Humanisation in pregnancy and childbirth: A concept analysis. J Clin Nurs. 2020; 29:1744-1757.
6. Misago C, Kendall C, Freitas P, Haneda K, Silveira D, Onuki D, Mori T, Sadamori T, Umenai T. From 'culture of dehumanization of childbirth' to 'childbirth as a transformative experience': changes in five municipalities in north-east Brazil. Int J Gynaecol Obstet. 2001; 75: S67-S72.
7. Hopkins K. Are Brazilian women really choosing to deliver by cesarean? Soc Sci Med. 2000, 51:725-740.
8. Misago C, Umenai T, Onuki D, Haneda K, Wagner M. Humanised maternity care. Lancet. 1999; 354:1391-1392.
9. Japan International Cooperation Agency. Work completion report 2021 – Research Project on Improvement of Quality of Care through the "Humanization of Childbirth". *https://openjicareport.jica.go.jp/pdf/12362737.pdf* (Accessed August 5, 2023). (in Japanese)
10. Ministério da Saúde no Brasil. Portria MS/GM Nº 985, de 05 de agosto de 1999. *https://cvs.saude.sp.gov.br/zip/Portaria%20GM%20MS%20n%C2%BA%20985,%20de%2005ago99.pdf* (accessed May 1, 2023).
11. Umenai T, Wagner M, Page LA, Faundes A, Rattner D, Dias MA, Tyrrell MA, Hotimsky S, Haneda K, Onuki D, Mori T, Sadamori T, Fujiwara M, Kikuchi S. Conference agreement on the definition of humanization and humanized care. Int J Gynaecol Obstet. 2001; 75: S3-S4.

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Perceptions of protective shoes and recommendations from patients with diabetic foot ulcers

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Abstract: Development of diabetic foot can cause serious harm to a patient's body and pose a heavy burden on family members and society. Protective shoes are of great significance to preventing diabetic foot. The aim of the current study was to understand patients' views and suggestions concerning the selection and promotion of protective shoes for diabetics in order to explore existing obstacles and to provide a reference for improving relevant public health care policies and clinical decision-making for patients with diabetic foot ulcers (DFUs). A total of 10 patients with DFUs were recruited. All participants completed a one-hour semi-structured interview, and results reflected the participants' choice of footwear, the patients' perceptions and acceptance of protective footwear, and factors influencing those processes. The use and promotion of protective shoes in China requires greater support, including improved medical insurance policies, promotion of multidisciplinary cooperation between medicine and industry in clinical practice, and better health education.

***Keywords*:** protective shoes, diabetic foot ulcers, footwear, qualitative study

Introduction

With the growing elderly population, the number of patients with diabetes is also increasing (*1*). Diabetic foot ulcers (DFUs) are one of the most serious chronic complications in patients with diabetes. DFUs refer to tissue infections, ulcers, or tissue injuries to the foot of patients with current or previously diagnosed diabetes, and they are usually accompanied by lower extremity neuropathy and/or peripheral artery disease (*2*). DFUs occur in 9.1 million to 26.1 million diabetic patients worldwide every year (*3*) and the treatment of DFUs is difficult, their prognosis is poor, and recurrence rates are high.

Wearing protective shoes is particularly important for prevention and management of DFUs. Australia issued the Guidelines for Footwear for Diabetic Patients in 2013 and 2018, which described the importance of wearing appropriate footwear to prevent foot ulcers (*4*). The Chinese guidelines for the prevention and treatment of DFUs suggest that orthopedic decompression designed and manufactured based on plantar pressure and foot shape can effectively prevent and reduce foot ulcers in high-risk patients (*5*). A study in the Netherlands, however, found that 33–82% of diabetic patients wear inappropriate shoes, and 21–33% of DFUs are caused by wearing unsuitable shoes or socks (*2*). A study in China found that more than 30% of diabetic patients had insufficient knowledge about proper shoe selection (*6*). A significant number of patients who have or may develop DFUs are reluctant to use protective shoes, which greatly increases the risk of foot ulcers developing and worsening (*7*).

Therefore, the aim of the current study was to explore the limitations in the promotion and use of protective shoes from the perspective of patients with DFUs through qualitative research in order to provide a reference to improve relevant public health care policies and clinical decision-making.

The state of and views on the use of protective shoes

A total of 10 patients were included in this study (Supplemental Data, *https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=71*). Patient characteristics are shown in Table 1. All of the participants had, at the time, a current foot ulcer problem, and the longest duration of a foot ulcer was nine years and the shortest was four months. Men preferred to wear cloth or leather shoes that are easy to put on and take off and that do not allow tightness to be adjusted. Women wore pointed sandals or slippers; an inappropriate heel height increases the weight borne by the heels and causes heel pain.

Six of the ten patients had never used protective footwear, three patients who had used protective

Table 1. Characteristics of study participants (n = 10)

Characteristics	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Age	48	56	68	74	68	74	73	42	68	64
Sex	Female	Male	Male	Female	Male	Female	Male	Male	Male	Male
Ethnicity	Han	Han	Han	Han	Han	Han	Han	Han	Han	Han
Level of education	Middle school	Middle school	Middle school	Primary school	Middle school	College	Undergraduate	High school	High school	Middle school
Marital status	Married	Married	Married	Widowed	Married	Married	Married	Married	Divorced	Married
Residence	Urban	Urban	Urban	Rural	Urban	Rural	Rural	Urban	Urban	Urban
Living alone	No	No	No	Yes	No	No	No	No	Yes	No
Annual household income (RMB)	<3000	>6000	3000-6000	<3000	>6000	>6000	>6000	>6000	>6000	3000-6000
Health insurance	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	House wife	Worker	Accountant	Unemployed	Worker	Primary school teacher	Designer	Engineer	Assistant	Administrative staff
Self-rated health status	Complete self-care	Complete self-care	Partial self-care	Partial self-care	Partial self-care	Partial self-care	Partial self-care	Complete self-care	Partial self-care	Partial self-care
Duration of diabetes (years)	< 10	10-15	> 15	10-15	> 15	10-15	10-15	10-15	10-15	< 10
Neurological/vascular lesions	+	+	+	+	+	+	+	+	+	+
Have used protective shoes	No	Yes	No	No	Yes	No	Yes	No	No	Yes

footwear ceased doing so for some reason, and only one patient continued to use protective footwear. Most patients had a certain level of understanding of the functions of diabetes footwear, but they do not know enough about the causes of DFUs and they often had too high or too low expectations of protective shoes.

In addition, studies have indicated that shoes for diabetics should be worn for at least 7 hours every day to achieve the desired effect (*8*). In the current study, however, patient compliance was low, which primarily reflects the choice of shoes when walking at home.

Factors influencing the perception and acceptance of protective shoes

Lack of education

Patients mostly obtained information from their relatives and friends rather than from guidance and recommendations from doctors and nurses. Thus, many patients lacked an in-depth understanding of the function of protective shoes, which may influence their choice of footwear. Moreover, the rehabilitative effectiveness of protective shoes may not be obvious to patients in a short period of time, so the importance of those shoes may be only appreciated over the long term. These factors prompt patients to be sceptical about the function of protective shoes.

Economic burden

Chinese researchers have found that the acceptable cost of protective shoes for patients is less than 500 yuan and that 32.96% of patients will not choose protective shoes because of the high price. Shoes for diabetics have been widely used in Europe, the United States, and other countries and are included in the medical insurance system. Due to gaps in relevant medical insurance systems in China, however, obtaining these shoes represents a significant economic burden, which affects the decision to buy them. As can be seen from the interviews, the wear of appropriate shoes by patients is related to socioeconomic factors, and the increased expenses may cause patients to abandon recommendations completely.

Imbalance between supply and demand

Options for protective shoes for diabetics are relatively limited, and there are relatively few types of protective shoes available on the market, so they are unable to meet the needs of patients wishing to wear corresponding types of protective shoes in different environments. The foot morphology of patients with diabetes, and especially elderly patients, changes due to age and condition, and it is often accompanied by abnormal foot structure, so the feet and shoes often do not match. At present, most shoes

Table 2. Perceptions of patients with diabetic foot ulcers regarding the use of protective shoes

Key concepts	Illustrative quotations from participants
Lack of education: Skeptical and/or lack in-depth understanding of the function of protective shoes	"Well…to be honest, I've never heard of certain shoes that can prevent foot ulcers, and no one at home ever mentioned such shoes." [H4]
	"I always feel that the dedicated protective shoes are heavy… so you know, I stand for a long time every day, which would make them inconvenient for my work." [H6]
	"I usually wear slippers, which feel good and which are breathable, cheap, easy to put on and take off, and do not apply pressure to my wound." [H9]
	"I've ordered those kind of shoes before, but they were not very comfortable to wear. ... . They were not as comfortable as normal shoes…so sometimes I'm afraid that they would worsen my wound..." [H2]
	" ... and wear them for about two months, but the plantar ulcers were not significantly alleviated. The shoes did not seem to have much of an effect...." [H10]
	"...the effectiveness of protective shoes will decrease after about 3 months of wear. I felt that the material was not advanced enough to convince me to buy them." [H8]
Economic burden: Protective shoes are expensive	"I always feel that they are not worth it… and the most expensive shoes I usually wear are 200 or 300 yuan. I think I should cut down on my walking, haha." [H5]
	"… they are…too…too expensive..... There is no sense in spending so much money to buy a pair of those shoes. " [H6]
	"...they cost me more than 900 yuan, which I had to pay myself. But hey... After all, the shoes are consumables, and I'm worried that they will deform after wear and cease to be effective." [H7]
	"I have heard of those shoes before, but my friend ordered the shoes for about 1,200 yuan, which is expensive." [H9]
Imbalance between supply and demand: The conflict between style and attention from others. Options for protective shoes for diabetics are limited and they are not available on the market.	"Will wearing such special shoes draw attention to my foot problems? If the answer is yes, er…I don't think I would choose to wear them…" [H1]
	"The doctor said that I should choose protective shoes, but I don't know the appropriate place to order from." [H3]
	"Protective shoes are not stylish or fashionable in appearance, and they are black." [H7]
	"Moreover, the production cycle is too long, and they take 1-2 months to arrive. " [H9]
	"My feet have been operated on and have deformities, but there is no place to buy shoes suitable for deformities."[H10]

for diabetics imported from abroad are not completely suitable for Chinese people because of the differences in foot type (*9*). Social situations pose a dilemma: although some patients know that foot protection is helpful for their foot rehabilitation, they often refuse to use protection shoes because they conflict with style and also draw attention to their health. A female patient said that the style of shoes has improved in recent years. Even so, the style of shoes may differ from what one normally wears. The perceptions of patients with diabetic foot ulcers regarding the use of protective shoes are shown in the Table 2.

Suggestions

Emphasizing health education

Improved patient education can delay the development of foot ulcers and prevent amputations in patients. Healthcare personnel must make clear the fact that the prescribed interventions should be translated into practical actions related to foot care. Health education for people with diabetes is a long-term important task for hospitals, the community, healthcare personnel, and families, and education needs to be followed up and evaluated so that patients can understand their limited knowledge regarding shoes and whether they can correctly use them as prescribed (*10*). Personnel should continue to refine the systems of shoe-related health education, develop professional, comprehensive, and systematic educational plans based on the individual circumstances of the patients, and expand methods of communication (manuals, congresses, and home visits) to provide patients and their families with prompt, systematic, and comprehensive health education in order to encourage them to shift from passive management to active participation in the self-management of their disease (*11,12*).

Formulating and improving social policies

The costs of preventing DFUs are far lower than the costs of treatment, and the health benefits of ulcer healing are far greater than the costs of protective shoes. In 2019,

the guidelines for the prevention of DFUs issued by the International Diabetic Foot Association included diabetic shoes as special assistive devices; the shoes were covered by medical insurance in developed countries in Europe and North America (*13*). These efforts have reduced the amputation rate among diabetics by more than 50% (*14*). In China, protective shoes are not covered by medical insurance, leading to limited use and promotion of protective shoes for patients with DFUs. Therefore, relevant systems need to be improved to help reduce the economic burden on patients and to encourage them to choose protective shoes.

In January 2023, the Ministry of Civil Affairs of China approved and issued "Diabetic Insole Configuration" as an industry standard. The issuance and implementation of this standard has far-reaching significance, but it is only the first step of a long march. There is still a long way to go to ensure the safety, effectiveness, and widespread promotion of protective shoes for diabetics.

Multidisciplinary collaboration in clinical practice

For maximum effect, protective shoes should be able to be worn by patients at any time without being limited to a season, place, or style (*15*). For example, indoor shoes be similar to outdoor shoes with respect to fit and ability to relieve pressure but should be distinguished from outdoor shoes with respect to the ease of wear and removal as well as the materials of manufacture (*16*) in order to improve patient compliance by wearing shoes indoors.

In China, most studies have focused on the preliminary verification and examination of foot protection footwear. The development and manufacture of appropriate protective shoes for different patients with DFUs depends on medical development and enhanced multidisciplinary cooperation with medical engineering. For the elderly population, the designer should simplify the function of protective shoes, reduce the number of steps to use protective shoes, shorten the production cycle as much as possible, and encourage patients to be more willing to accept protective shoes (*17*). More attractive styling of protective shoes is related to a higher level of compliance. In addition, plantar pressure measurement technology can be applied to the design of diabetes shoes (*18*) to permit monitoring of plantar pressure at any time and anywhere. This would permit analysis of the health status of human feet through plantar pressure levels and distribution (*19*). Footwear design is changing from an experience-based and skill-based approach to a more scientific data-driven approach, and more experimental research is needed to support this transition.

In conclusion, this study found that Chinese participants' use of protective shoes for diabetics is influenced by the financial burden, the availability of footwear resources to meet demand, and health education received. This study has shed light on these complexities and it raises some questions to consider. The course of this study suggests that participants' concerns about the footwear are often overlooked in clinical settings. Patients need to constantly weigh the advantages and disadvantages of wearing protective shoes because there are few available footwear options, hampering the promotion and use of protective shoes. Protective shoes are recommended as a means to address the emotional, social, and physical needs of diabetic patients rather than just serving as a medical device. Such changes will depend on improved policies, multidisciplinary cooperation, health education from medical teams, and family and community support.

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References

1. Yan Y, Wu T, Zhang M, Li C, Liu Q, Li F. Prevalence, awareness and control of type 2 diabetes mellitus and risk factors in Chinese elderly population. BMC Public Health. 2022; 22:1382.
2. van Netten JJ, Bus SA, Apelqvist J, Lipsky BA, Hinchliffe RJ, Game F, Rayman G, Lazzarini PA, Forsythe RO, Peters EJG, Senneville É, Vas P, Monteiro-Soares M, Schaper NC; International Working Group on the Diabetic Foot. Definitions and criteria for diabetic foot disease. Diabetes Metab Res Rev. 2020; 36 Suppl 1:e3268.
3. Sorber R, Abularrage CJ. Diabetic foot ulcers: Epidemiology and the role of multidisciplinary care teams. Seminars in Vascular Surgery. 2021; 34:47-53.

4. Bergin SM, Nube VL, Alford JB, Allard BP, Gurr JM, Holland EL, Horsley MW, Kamp MC, Lazzarini PA, Sinha AK, Warnock JT, Wraight PR. Australian Diabetes Foot Network: Practical guideline on the provision of footwear for people with diabetes. J Foot Ankle Res. 2013; 6:6.
5. Chinese Diabetes Society, Chinese Society of Infectious Diseases, Chinese Society for Tissue Repair and Regeneration. Chinese guideline on prevention and management of diabetic foot (2019 edition) (I). Chin J Diabetes. 2019; 11:92-108. (in Chinese)
6. Fan LF, Zhang XQ, Hao JL, Shao L, An J, Fan L, Zheng YG. Study on the knowledge of choosing proper shoes and sock wears on 530 patients with diabetes. Chinese Journal of Practical Nursing. 2005; 21:10-12. (in Chinese)
7. van Netten JJ, Lazzarini PA, Armstrong DG, Bus SA, Fitridge R, Harding K, Kinnear E, Malone M, Menz HB, Perrin BM, Postema K, Prentice J, Schott KH, Wraight PR. Diabetic Foot Australia guideline on footwear for people with diabetes. J Foot Ankle Res. 2018; 11:2.
8. Paton JS, Stenhouse EA, Bruce G, Zahra D, Jones RB. A comparison of customised and prefabricated insoles to reduce risk factors for neuropathic diabetic foot ulceration: A participant-blinded randomised controlled trial. J Foot Ankle Res. 2012; 5:31.
9. Keukenkamp R, Busch-Westbroek TE, Barn R, Woodburn J, Bus SA. Foot ulcer recurrence, plantar pressure and footwear adherence in people with diabetes and Charcot midfoot deformity: A cohort analysis. Diabet Med. 2021; 38:e14438.
10. Goodall RJ, Ellauzi J, Tan MKH, Onida S, Davies AH, Shalhoub J. A systematic review of the impact of foot care education on self efficacy and self care in patients with diabetes. Eur J Vasc Endovasc Surg. 2020; 60:282-292.
11. Bus SA, van Netten JJ, Lavery LA, Monteiro-Soares M, Rasmussen A, Jubiz Y, Price PE; International Working Group on the Diabetic Foot. IWGDF guidance on the prevention of foot ulcers in at-risk patients with diabetes. Diabetes Metab Res Rev. 2016; 32 Suppl 1:16-24.
12. Mekonen EG, Gebeyehu Demssie T. Preventive foot self-care practice and associated factors among diabetic patients attending the University of Gondar Comprehensive Specialized Referral Hospital, Northwest Ethiopia, 2021. BMC Endocr Disord. 2022; 22:124.
13. IWGDF. IWGDF Guideline on the prevention and management of diabetic foot disease. www.iwgdfguidelines.org (accessd June 20, 2023)
14. Bu sSA. The role of pressure offloading on diabetic foot ulcer healing and prevention of recurrence. Plast Reconstr Surg. 2016; 138:179S-187S.
15. Jarl G, Hulshof CM, Busch-Westbroek TE, Bus SA, van Netten JJ. Adherence and wearing time of prescribed footwear among people at risk of diabetes-related foot ulcers: Which measure to use? Sensors (Basel). 2023; 23:1648.
16. Keukenkamp R, van Netten JJ, Busch-Westbroek TE, Bus SA. Custom-made footwear designed for indoor use increases short-term and long-term adherence in people with diabetes at high ulcer risk. BMJ Open Diabetes Res Care. 2022; 10:e002593.
17. Waaijman R, Keukenkamp R, de Haart M, Polomski WP, Nollet F, Bus SA. Adherence to wearing prescription custom-made footwear in patients with diabetes at high risk for plantar foot ulceration. Diabetes Care. 2013; 36:1613-1618.
18. Najafi B, Reeves ND, Armstrong DG. Leveraging smart technologies to improve the management of diabetic foot ulcers and extend ulcer-free days in remission. Diabetes Metab Res Rev. 2020; 36 Suppl 1:e3239.
19. Crawford F, Nicolson DJ, Amanna AE, Smith M. Reliability of the evidence to guide decision-making in foot ulcer prevention in diabetes: An overview of systematic reviews. BMC Med Res Methodol. 2022; 22:274.

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Issues in enhancing continuing professional development for midwives in clinical practice in Mongolia

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Abstract: Midwives are professionals who fulfill maternal and child health needs. In Mongolia, midwives were unable to transfer their knowledge and skills to the next generation midwives last few decades. The details of their experiences and the comprehensive aspects of continuing professional development (CPD) are still unclear. This study aimed to assess the current status of midwives in clinical practice through an online symposium. Relevant information was collected from presentations, question-and-answer sessions, and questionnaires. It was found that CPD has unclear training plans, no specialized training, and with them having little experience with CPD. Newly graduated midwives do not have an educational program. As of the current status, midwifery services are not provided at the clinical site in the scope of midwifery job descriptions. This study also discusses the situation of low status and salary in midwifery. Strengthening the system of midwifery CPD like development of the educational program is needed.

***Keywords*:** continuing professional development, midwife, job description, Mongolia

Introduction

Sexual, reproductive, maternal, newborn, and adolescent health (SRMNAH) is an essential component of achieving Sustainable Development Goals. According to the State of the World's Midwifery 2021 report (*1*), midwives can fulfill 90% of the needs for SRMNAH services if they are fully educated, licensed, and integrated with an interdisciplinary team.

As a policy of the Mongolian government, primary medical services such as prenatal checkups are provided at primary healthcare facilities, and care during childbirth or for pregnant women with complications is provided at referral-level hospitals (*2,3*). In Mongolia, the National Program, "Maternal, Child, and Reproductive Health" (*4*) was adopted in 2017. Implementation of the policies reduced maternal and child deaths. These programs have resulted in 99.7% of all pregnant women giving birth in a hospital by 2020 (*5*). As for midwives, the Center for Health Development (CHD) has been issuing midwifery licenses since 1999, and the midwifery job description was declared as a decree of the Minister of Health in 2017 (*6*). In Mongolia, 1,119 people were working as midwives by 2020 (*4*).

Midwives faced various difficulties in their pursuance of their education and roles. According to the materials of "Core Competency of Midwives" by the Mongolian National University of Medical Sciences in 2018 (*7*), there was a period when midwifery education for midwives was suspended from 1993 to 2003 and midwifery as a practice was suspended from 2000 to 2017. During this period of suspended midwifery education and work, it was not possible to transfer knowledge and skills from midwives to midwives. Thus, there are no data on the comprehensive aspects of continuing professional development (CPD) or the details of midwives' experiences. This study aimed to assess the current situation of midwives in clinical practice through an online symposium aimed at strengthening CPD for midwives in Mongolia.

Online symposium

Table 1. Questions of questionnaire by google forms

Participant characteristics
○What is your position?
○How many years of experience do you have?
Satisfaction of online symposium
○How satisfied are you with the online symposium? Choose from 5 levels.
○What is the reason for your satisfaction rating?
Experience in CPD
○What CPD have you attended in the past?
Midwifery service and job description
○How consistent are job descriptions with clinical practice?
Let us know if there are any themes you would like to have in online symposiums

The online symposium was organized by the Mongolian Midwives Association, the Mongolian National University of Medical Sciences, the Ministry of Health, and the Japan International Cooperation Agency's project for strengthening post-graduate training for medical doctors and nurses to discuss the current situation of midwives in clinical practice on December 16, 2021.

Midwives of eight out of all 37 hospitals in Mongolia that handled childbirth, presented their current situation of *i*) CPD, *ii*) education for newly graduated midwives, and *iii*) to what extent the job description for midwives adhered to in clinical practice. These eight hospitals were chosen as the main maternal hospitals that handle approximately 60% of the births in Mongolia.

After the presentations, a question-and-answer session was conducted for 20 minutes. The organizers shared the questionnaire with the participants. For ethical considerations, the questionnaires (Table 1) were filled out anonymously by the participants of the online symposium who agreed to participate in the study and completed the investigation using Google forms.

Information for this study was collected from the presentations, question-and-answer sessions, and questionnaires at an online symposium.

Information from the presentations

The issues identified in the eight hospital presentations were common. It was found that the CPD has problems like unclear training plans, no specialized training for midwives, no textbooks, and poor training environment, and lack of support for CPD. The CPD was necessary to strengthen the capabilities of clinical midwives. They also opined that ultrasound and family planning training are necessary. Regarding the education for newly graduated midwives, there were no educational programs and no trainers for newly graduated midwives at the clinical site. Regarding the midwifery service and job description, they explained that midwives at the clinical site could not follow their job descriptions. Because the most of the other health professionals such as medical doctors and nurses are not familiar with midwifery job description, there is a lack of an environment in which midwives can work according to the job description, like performing a pelvic exam to diagnose labor progress.

Other issues identified by the midwives in clinical sites were that other health professionals do not understand the value of the midwifery profession, the need to clarify the division of roles between doctors and midwives in obstetric care, and low salaries for midwives.

Table 2. Characteristics and answer of survey (n = 44)

Characteristics and answers	n (%)
Position	
Midwife	35 (79.5)
Midwife and Associate Doctor	4 (9.1)
Director of Nursing Department	2 (4.5)
Head Midwife	2 (4.5)
Deputy Director of Nursing Department	1 (2.3)
Years of clinical experience	
0–4 years	9 (20.5)
5–9 years	7 (15.9)
10–14 years	11 (25.0)
15–19years	1 (2.3)
20–24 years	4 (9.1)
25–29 years	7 (15.9)
30 and more	5 (11.4)
Experience in CPD	
Advanced training of one month	7 (15.9%)
Neonatal Cardio-Pulmonary Resuscitation	5 (11.4%)
Training of Trainer	2 (4.5%)
Intensive care	1 (2.3%)
Procedure of IUD	1 (2.3%)
Others (written as credit training and is not specified)	13 (29.5%)
None	15 (34.1%)
Satisfaction of online symposium	
Very satisfied	39 (88.6)
Satisfied	3 (6.8)
Neither	1 (2.3)
Unsatisfied	1 (2.3)
Very unsatisfied	0 (0)

Information from the question-and-answer session

Various issues, like low social awareness of midwives and low salaries, were discussed in the question-and-answer session. Moreover, two specialists from the Ministry of Health shared that specialized training for midwives just started to develop in 2021, and that measures regarding salaries are now being considered.

Information from questionnaire

The online symposium was accessed one hundred and fifteen, and 44 (38.2%) responded to the questionnaire on the Google Forms (Table 2).

Participant characteristics

It was found that of the total participants, there were 35 midwives (79.5%), four "midwife and associate doctor" (9.1%), two head midwives (4.5%), two directors of the nursing department (4.5%), and a deputy director

of the nursing department (2.3%). The years of clinical experience of the participants ranged from one year to 34 years.

Experience in CPD

Of the total participants, seven participants (15.9%) had advanced training, five (11.4%) had training in neonatal cardiopulmonary resuscitation, and 15 (34.1%) never had a chance to attend any training. The participants added comments like, "There is no information for CPD for midwives", and "Midwives have too many tasks. Because of the shortage of midwives, we cannot have time to have training".

Satisfaction of online symposium

Regarding satisfaction with the online symposium, 42 participants (95.4%) reacted to this event as "very satisfied" and "satisfied". Most of them commented that the themes were facing serious issues for midwives, such as CPD or job descriptions. One respondent (2.3%) who indicated "neither" satisfaction commented that she was unable to attend the entire online symposium. One unsatisfied respondent (2.3%) commented on dissatisfaction with the work environment, including communication problems in the workplace, lack of courtesy, and the need for inter-organizational coordination to strengthen CPD.

Education for newly graduated midwives

The participants added comments like "There is no manual or educational program for newly graduated midwives", and "Newly graduated midwives need clinical trainers". The participants opined that it is necessary to educate newly graduated midwives at clinical sites.

Midwifery service and job description

To the question, "to what extent are midwives' job descriptions adhered to in clinical practice at each hospital?", 27 participants (61.4%) answered that they had observed severe discrepancies, and seven (15.9%) faced a moderate amount of discrepancies. They further commented, "We can deliver midwifery service, but doctors do not allow us to do so", "Only midwives who work in rural prefectures, can follow the job description".

Needs of themes of next online symposiums or study sessions

Eleven participants (25%) requested training to hone the professional skills of midwives, five (11.4%) requested specialized training, three (6.8%) needed training in obstetric emergency and neonatal resuscitation, and two (4.5%) needed ultrasound training.

Free comment

These were other free comments, "The reality is difficult to become midwives of international standard level", "There are many people who do not know the profession of midwives", "Low status and low salary", "We do not want to be like an assistant for doctors. We could deliver midwifery services for women and infants", "We do not have enough midwives. One midwife is doing the work of two or three midwives".

Social background and expectations for midwife

There is no formal documentation of the social background and factors behind the suspension of midwifery education and practice in Mongolia. As for how the situation of midwives has changed and improved, there were needs for midwives from clinical sites, and midwifery education has been resumed in 2003 and work has started in 2017. In addition, expectations for midwives increased due to their active role in the coronavirus disease 2019 (COVID-19) pandemic. Therefore, the Minister of Health decree mandated the development of specialized training course for midwives in 2021 (*8*) and started to strengthen post-graduate education for midwives.

Analysis of current situation by analytical framework

The analytical framework of a house model was used to assess the current situation of the midwives. The National Center for Global Health and Medicine, Japan, has developed the house model as a comprehensive and visible framework for human resource systems (*9,10*). The house model can be comprehensively analyzed using eleven components, like available human resources, legal framework, finance, protection, deployment, and retention, to build a health system. It was developed by comparing the health system with the house. Just as one cannot build a stable house if any part of the house is weak – the pillars, roof, or soil – health systems need a holistic view to be more resilient.

The house model was used for the analysis of information from the online symposium, their presentations, their discussions, and the result of the questionnaire. Challenges were found in the retention and deployment parts. Retention includes continuous education and deployment includes recruitment.

Retention includes continuous education

Through the symposium, it was clear that CPD was not systematically implemented, and that there were no specific programs or training the trainers required to train newly graduated midwives. One-third of the midwives

had never had a chance to attend relevant training. It is thus, necessary to complete the minimum number of credits required to renew a midwifery license every five years. There are no educational programs available for newly graduated midwives. In Mongolia, a newly graduated midwife normally follows an experienced midwife as a pair to learn how to care for patients and infants. There is an obvious dearth of strategic programs for CPD of midwives (*11*). For better midwifery care, strengthening the CPD system is crucial for stabilizing the roof and addressing health needs in the house model.

Deployment includes the recruitment

Deployment of proper training in midwifery is also a challenge in Mongolia. Thus, the shortage of midwives is a serious problem. Some participants said that they were working in understaffed departments, with one midwife doing the work of two or three. Unforeseen emergencies may occur during the childbirth, and personnel allocation is important for ensuring the safety and quality of medical care.

Recommendation for strengthening CPD of midwife

The CPD is explained in detail in a variety of scopes around the world; for example, CPD is related to professional licensing systems for renewing licenses (*12*), it is linked to regulations (*13*), and lifelong professional motivation and improvement of knowledge and skills (*12,14*). Furthermore, to strengthen CPD as a system, it is recommended that related organizations at all levels work together to secure sustainable costs, establish a system to confirm regulations and curricula to ensure quality, and support CPD attendance in the workplace (*15*).

In Mongolia, licensing systems for midwives and license renewal systems have been developed since 1999. The CPD plays a major role in providing the safe and comfortable midwifery services to meet the needs of women and society. To implement training for improving and updating the capabilities of midwives, it is necessary to prepare a workplace environment in which they can attend training and gain a budget. Moreover, creating a system that ensures training quality is crucial.

Thus, this study revealed midwives at clinical sites have little experience with CPD. Better midwifery care could lead to a better life for pregnant women, fetuses, newborns, women, children, and all family members. To strengthen CPD including developing an educational program for newly graduated midwives, and to establish the environment for midwives such as understanding of their professionals, status, welfare, *etc*., are needed.

This study has several limitations. This is not representative of midwife population as a whole in Mongolia, as midwives interested in the topic may have attended and responded to the online symposiums. In future, it is, thus, necessary to conduct a complete survey to grasp the current situation of midwives to establish a relevant CPD system and implementing relevant policies.

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References

1. United Nations Population Fund. The State of the World's Midwifery 2021. *https://www.unfpa.org/sites/default/files/pub-pdf/21-038-UNFPA-SoWMy2021-Report-ENv4302_0.pdf* (accessed February 21, 2023).
2. Mongolian Ministry of Health. Regulatory approval 338 2014. *https://moh.gov.mn/uploads/files/fc6f9fdc105b814bfd15e00c31f02d20827f9d7b.pdf* (accessed March 13, 2023). (in Mongolian)
3. Mongolian Ministry of Health. Regarding revision of regulations, Regulations on medical services during pregnancy, labor and postpartum A/318 2020. *https://moh.gov.mn/uploads/files/033493f9169edcbf34480d95dcd1aa46.pdf* (accessed March 13, 2023). (in Mongolian)
4. Mongolian government. National Program "Maternal, Child and Reproductive Health". March 2017. *https://legalinfo.mn/mn/detail?lawId=207743&showType=1* (accessed February 27, 2023). (in Mongolian)
5. Mongolian Center for Health Development. Health indicators 2021. *http://www.hdc.gov.mn/media/files/em%20uzuulelt%202021.pd*f (accessed February 27, 2023).
6. Mongolian Ministry of Health. Midwifery job descriptions A/216 2017. *https://moh.gov.mn/uploads/files/a0ac8e17add3b286bec023d5b7c4e10a3216f213.pdf* (accessed February 27, 2023). (in Mongolian)
7. Mongolian National University of Medical Sciences. Core Competency of Midwives ~Midwifery team~. B. Bayasgalanmunkh, Ulaanbaatar, Mongolia, 2018; pp.2-10. (in Mongolian)
8. Mongolian Ministry of Health. Health index A/445 2021. *https://moh.gov.mn/uploads/files/861a1436bb915cea637f7f39cda661d9d3533629.pdf* (accessed July 20, 2023). (in Mongolian)
9. Fujita N, Zwi AB, Nagai M, Akashi H. A comprehensive framework for human resources for health system development in fragile and post-conflict states. PLoS Med. 2011; 8:e1001146.
10. Fujita N, Nagai M, Diouf ISN, Shimizu T, Tamura T. The role of a network of human resources for health managers in supporting leadership for health systems strengthening in francophone African countries. Health Syst Reform. 2016; 2:254-264.
11. Dovdon B, Park CS, McCarley N. Nursing policy and

practice in Mongolia: Issues and the way forward. Int Nurs Rev. 2022; 69:265-271.
12. Gray M, Rowe J, Barnes M. Continuing professional development and changed re-registration requirements: Midwives' reflections. Nurse Educ Today. 2014; 34: 860-865.
13. Michel-Schuldt M, Billy Dayon M, Toft Klar R, Subah M, King-Lincoln E, Kpangbala-Flomo C, Broniatowski R. Continuous professional development of Liberia's midwifery workforce – A coordinated multi-stakeholder approach. Midwifery. 2018; 62:77-80.
14. Mlambo M, Silén C, McGrath C. Lifelong learning and nurses' continuing professional development, a metasynthesis of the literature. BMC Nurs. 2021; 20:62.
15. Feldacker C, Pintye J, Jacob S, Chung MH, Middleton L, Iliffe J, Kim HN. Continuing professional development for medical, nursing, and midwifery cadres in Malawi, Tanzania and South Africa: A qualitative evaluation. PLoS One. 2017; 12: e0186074.

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LETTER
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Advanced age – a critical risk factor for recurrent miscarriage

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Abstract: Recurrent spontaneous abortion (RSA) is a multifactorial disease that seriously affects women's physical and mental health. With the advent of efficient contraception, the trend for women towards later maternity until their thirties or even forties. Nevertheless, the risk of miscarriage is strongly related to maternal age. We performed a retrospective analysis to evaluate the etiology of RSA through age groups. The results demonstrated that intrauterine adhesions and ovarian dysfunction were responsible for increased miscarriages in older RSA patients. In conclusion, older women will bear a higher risk of miscarriage, mainly due to uterine adhesions or decreased ovarian function.

***Keywords*:** maternal age, recurrent spontaneous abortion, etiology, outcome of pregnancy

Recurrent spontaneous abortion (RSA) is a multifactorial disease that seriously affects women's physical and mental health (*1*). The average population of women with one pregnancy loss is 10.8%, among which approximately 1.9% have experienced two consecutive miscarriages, and 0.7% have gone through three or more (*2*). Different national guidelines have different definitions of RSA in terms of the number of abortions, gestational age, and continuity of abortions (*2-4*). The Chinese expert consensus released in 2022 defined RSA as the loss of two or more failed clinical pregnancies before 28 weeks with the same sexual partner and pointed out that the occurrence of two consecutive abortions should be paid attention to and evaluated (*4*).

Nowadays, with the advent of efficient contraception, the trend for women towards later maternity until their thirties or even forties (*5*); however, the risk of miscarriage depends on the defined upper maternal age (*6*). The risk rises nearly linearly after age 30 to reach 54% at ages 45 and over, along with decreased egg quality and quantity sharply and an increased rate of mitochondrial DNA mutation and meiosis error (*6*). What's more, the rate of embryo chromosome abnormality in older women is much higher than in women of appropriate age (*7*). Due to the relatively high incidence rate of miscarriage, advanced maternal age has become one of the significant challenges for reproductive medicine. Here, we also designed a retrospective study to evaluate the etiology of RSA based on age grouping, which will benefit pregnant women at an advanced age.

The retrospective study includes 387 RSA patients, which were categorized into two groups depending on age: An older group (≥ 35 years older, n = 83) and a younger group (< 35 years older, n = 304). There was no significant difference in the body mass index (BMI) and the number of miscarriages between the two groups ($p > 0.05$) (Supplemental Table S1, *https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=69*). Our results demonstrated that the older RSA patients had a higher incidence of intrauterine adhesions (IUA) and ovarian dysfunction than the younger counterparts ($p < 0.05$) due to aging and intrauterine surgery (Table 1), consistent with a previous study (*8,9*). IUA, a common gynecological and reproductive function uterine disease, strongly influences women's health, becoming one of the leading causes of menstrual loss, abortion, and secondary infertility. All IUA patients are high-risk pregnancies, which is associated with uterine deformation, volume reduction, or insufficient endometrial blood supply caused by IUA, easily leading to post-pregnancy abortion (*10*). Furthermore, the risk of IUA increases with the number of miscarriage procedures performed

Table 1. The detailed comparison of RSA causes in the different age groups

Causes of RSA	Aged < 35 (n = 304)	Aged ≥ 35 (n = 83)	p value
Chromosome (%)	11 (3.6)	4 (4.8)	0.538
Anatomy (%)	10 (3.3)	10 (12)	0.003*
Bicornuate uterus	1 (0.3)	0	1.000
Mediastinal uterus	4 (1.3)	2 (2.4)	0.613
Adenomyosis	0	1 (1.2)	0.214
Uterine fibroids	1 (0.3)	0	1.000
Intrauterine adhesions	3 (1.0)	6 (7.2)	0.004*
Cervical insufficiency	1 (0.3)	1 (1.2)	0.383
Endocrine (%)	71 (23.4)	21 (25.3)	0.771
Hyperthyroidism	5 (1.6)	2 (2.4)	0.646
Hypothyroidism	5 (1.6)	2 (2.4)	0.646
Subclinical hypothyroidism	27 (8.9)	7 (8.4)	0.898
Polycystic ovary syndrome	6 (2.0)	1 (1.2)	1.000
Decreased ovarian function	1 (0.3)	8 (9.6)	0.000*
Impaired glucose tolerance	5 (1.6)	0	0.589
Insulin resistance	34 (11.2)	4 (4.8)	0.097
Autoimmue (%)	74 (24.3)	23 (27.7)	0.568
AsAb	10 (3.3)	1 (1.2)	0.469
EMAb	9 (3.0)	3 (3.6)	0.726
TPOAb	20 (6.6)	5 (6.0)	1.000
TGAb	14 (4.6)	7 (8.4)	0.177
ACA	6 (2.0)	1 (1.2)	1.000
α-β2GP1	27 (8.9)	10 (12.0)	0.401
ANA	11 (3.6)	4 (4.8)	0.538
Coagulation (%)	19 (6.3)	2 (2.4)	0.272
Higher D-dimer	12 (3.9)	1 (1.2)	0.315
Hyperhomocysteinemia	7 (2.3)	1 (1.2)	1.000
Infection (%)	35 (11.5)	5 (6.0)	0.161
Unexplained (%)	146 (48.0)	34 (41.0)	0.266

Data are n (%); RSA: recurrent spontaneous abortion; AsAb: anti-sperm antibody; EMAb: anti-endometrial antibody; TPOAb: anti-thyroid peroxidase antibody; TGAb: anti-thyroglobulinantibody; ACA: anti-cardiolipin antibodies; anti-β2GP1: anti-β2-glycoprotein 1 antibody; ANA: antinuclear antibody; *$p < 0.05$.

(*11*). There were no statistically significant differences in chromosomal abnormalities, endocrine abnormalities, autoimmune abnormalities, coagulation abnormalities, and infection factors between the two groups (Table 1). Hormone levels are significant factors affecting the success of embryo implantation and pregnancy rates. As shown in (Supplemental Table S2, *https://www.globalhealthmedicine.com/site/supplementaldata.html?ID=69*), the level of AMH in the older patients with three or more abortions was significantly lower than that in the older sporadic abortion group ($p < 0.05$), in agreement with the previous result that a low AMH level is associated with high abortion rates in women older than 34 years old (*12*).

This study investigated the etiology composition of RSA based on age factors. In conclusion, intrauterine adhesions and ovarian dysfunction increased the number of abortions in older RSA patients (≥ 35 years older). More research is needed to elucidate the etiology and mechanisms for recurrent spontaneous abortion.

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References

1. Practice Committee of the American Society for Reproductive Medicine. Definitions of infertility and recurrent pregnancy loss: A committee opinion. Fertil Steril. 2020; 113:533-535.
2. Quenby S, Gallos ID, Dhillon-Smith RK, *et al*. Miscarriage matters: The epidemiological, physical, psychological, and economic costs of early pregnancy loss. Lancet. 2021; 397:1658-1667.
3. ESHRE Guideline Group on RPL, Bender Atik R, Christiansen OB, Elson J, Kolte AM, Lewis S, Middeldorp S, Nelen W, Peramo B, Quenby S, Vermeulen N, Goddijn M. ESHRE guideline: Recurrent pregnancy loss. Hum Reprod Open. 2018; 2018:hoy004.
4. Obstetrics Subgroup, Chinese Society of Obstetrics and Gynecology, Chinese Medical Association, Chinese Expert Consensus Group on Diagnosis and Management of Recurrent Spontaneous Abortion. Chinese expert consensus on diagnosis and management of recurrent spontaneous abortion (2022). Zhonghua Fu Chan Ke Za Zhi. 2022; 57:653-667. (in Chinese)
5. Bedenk J, Vrtačnik-Bokal E, Virant-Klun I. The role of anti-Müllerian hormone (AMH) in ovarian disease and infertility. J Assist Reprod Genet. 2020; 37:89-100.
6. Magnus MC, Wilcox AJ, Morken NH, Weinberg CR, Håberg SE. Role of maternal age and pregnancy history in risk of miscarriage: Prospective register based study. BMJ. 2019; 364:l869.
7. Huang Y, Tu M, Qian Y, *et al*. Age-dependent metabolomic profile of the follicular fluids from women undergoing assisted reproductive technology treatment. Front Endocrinol (Lausanne). 2022; 13:818888.
8. Bunnewell SJ, Honess ER, Karia AM, Keay SD, Al Wattar BH, Quenby S. Diminished ovarian reserve in recurrent pregnancy loss: A systematic review and meta-analysis. Fertil Steril. 2020; 113:818-827.
9. Carbonnel M, Pirtea P, de Ziegler D, Ayoubi JM. Uterine factors in recurrent pregnancy losses. Fertil Steril. 2021; 115:538-545.
10. Li B, Zhang Q, Sun J, Lai D. Human amniotic epithelial

cells improve fertility in an intrauterine adhesion mouse model. Stem Cell Res Ther. 2019; 10:257.
11. Hooker AB, de Leeuw RA, Emanuel MH, Mijatovic V, Brolmann HAM, Huirne JAF. The link between intrauterine adhesions and impaired reproductive performance: A systematic review of the literature. BMC Pregnancy Childbirth. 2022; 22:837.
12. Zarek SM, Mitchell EM, Sjaarda LA, Mumford SL, Silver RM, Stanford JB, Galai N, Schliep KC, Radin RG, Plowden TC, DeCherney AH, Schisterman EF. Antimüllerian hormone and pregnancy loss from the effects of aspirin in gestation and reproduction trial. Fertil Steril. 2016; 105:946-952.e942.

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