
Draft prepared on: 10 August 2020

Prepared for the WHO Centre for Health Development (WHO Kobe Centre -WKC)
by: Rei Ono,¹ Pakarattee Chaiyawat,² Gea Melinda,¹ Yamato Tsuboi,¹ Rika Kawaharada,¹ Perrein Emeline,¹ Fukuda Haruhisa³

Affiliations: ¹Department of Public Health, Graduate School of Health Sciences, Kobe University, ²Faculty of Physical Therapy, Mahidol University, ³Department of Health Care Administration and Management, Graduate School of Medical Sciences, Kyushu University

Corresponding author: Rei Ono

Responsible WHO Officer: Megumi Rosenberg

Send comments to: Rei Ono at ono@phoenix.kobe-u.ac.jp with Cc: to Megumi Rosenberg at kanom@who.int
Introduction

The world population as a whole is expected to age significantly in the next 30 years [1, 2]. Specifically, the populations of low- and middle-income countries (LMICs), which are relatively young currently, will age remarkably by 2050 [3]. For example, China in 2050 will have 348.8 million older people (aged 60 and above), which is equal to the total projected populations of Japan, Egypt, Germany, and Australia combined. In addition, over the same time, at least 13 LMICs in Asia are projected to experience a quadrupling of their aged 80 and over population [4].

In general, aging populations are the result of declining fertility and increasing longevity. Longer lives with good health are advantageous for both individuals and societies. Older people will have more years to engage in activities they did not have the chance to do during their earlier years, such as hobbies. Society also will be affected positively by having older people act as mentors or caregivers. Conversely, declining health also affects older people and societies adversely [5-7].

Recent research has found older people in LMICs are at risk of suffering from emerging noncommunicable diseases that lead to chronic diseases and disabilities. In addition, communicable diseases are a constant, and potential pandemics are foreseeable [8-10]. These conditions will complicate health problems and overburden health systems [4, 11]. Previous research has also alerted about how rapidly aging populations in LMICs may impact the efforts of those countries to achieve universal health coverage (UHC), which is one target of the Sustainable Development Goals [10-13]. However, many LMICs are struggling to measure progress towards UHC with consideration of epidemiological and demographic changes [10, 14].

Several attempts to monitor recent progress toward UHC have been made, including the Global Monitoring Report, which examined UHC progress in 132 countries [15-20]. Global monitoring evaluates two broad components: service coverage and financial protection [16, 21].
Although both components are essential to monitoring UHC progress [22], in the present study we focus on improvements of service coverage monitoring. Age- and disease-specific indicators within global monitoring systems, however, are dominated by maternal, child, and infectious disease indicators [23, 24], making them ineffective at monitoring the progress of service coverage in LMICs with aging populations because of a failure to adequately consider the demographic and epidemiological profiles [7, 14]. Good monitoring of service coverage is essential for understanding the latest national situation and would allow governments to evaluate their progress towards UHC and make proper adjustments [25, 26].

To facilitate the monitoring of service coverage in LMICs with aging populations, we proposed a life course approach. Life course approaches promote maximizing an individual’s functional ability throughout the lifespan, rather than age- or disease-based examinations, to achieve healthy aging by considering the long-term effects of both current health status and developmental processes such as socioeconomic and environmental exposures [27-30]. Thus, a life course approach could support integrating service coverage monitoring by horizontally including all ages while considering holistic domains, i.e. health, social, and environment. Moreover, a life course approach helps LMICs take care of their younger populations while at the same time preparing for aging populations by examining earlier life conditions to prevent later life risks [23, 29].

Previous studies had adapted the life course approach to health [23, 27, 28] and to UHC monitoring [25, 29]. However, to our knowledge, there is no framework to help governments respond to demographic and epidemiological changes in service coverage monitoring, particularly with regards to aging populations in LMICs. Using the service coverage index [20], the present study aimed to (1) develop a conceptual framework for a life course approach toward service coverage monitoring and (2) analyse current scientific literature on the application of a life course approach to health policies, services, and interventions to identify possible areas for future research on service coverage monitoring.
Our findings could support national and international efforts to monitor key policies, services, and interventions as part of service coverage to ensure the well-being of all populations in LMICs.

Methods

For this study, we used a proposed conceptual framework to guide our scoping review of the literature. We consulted our initial draft to experts from Indonesia and Thailand. The process took place between April 2019 until July 2020. Our main team consisted of diverse nationalities including Japan, France, Thailand, and Indonesia and expertise in geriatrics, community health, and health financing. We conducted the main investigation of the conceptual framework to facilitate the literature review and later carried a consultation about the initial draft with experts from Indonesia and Thailand about our initial draft from April 2019 to July 2020 through e-mail. Experts were identified by the author of a related article about UHC in LMICs.

Conceptual framework

We developed a conceptual framework to combine existing concepts and to present how the life course approach may be helpful to respond to demographic and epidemiological changes. We referred to a previous article about conceptual framework developments in general [31] and simultaneously referred to developments in life course approaches. First we conducted a literature search with the following combination of keywords: “life course approach”, “framework”, “health”, and “universal health coverage”, and did a snowball sampling of the related references (Table 2). Second, we included six previous studies that describe a life course approach in health or UHC monitoring [23, 25, 28, 29, 32]. Third, we reviewed five previous articles to discover similar or contradictory concepts among articles. Fourth, we grouped together concepts with similarities into one new concept. Finally, we synthesized our new concept narratively so that the conceptual framework could be understood.
We used the conceptual framework to guide the literature review and interpret the results. Moreover, we pointed out gaps between the literature review regarding the conceptual framework and recent global monitoring.

Literature review

A literature review was carried out using the scoping review method. The scoping review is a suitable method to achieve our research objectives, because the body of literature about policies/services/interventions for life course approaches to healthy aging is limited, complex, and diverse. A scoping review is useful for assessing the extent, range, and nature of research activity to map fields of study as well to identify knowledge gaps in a given topic [33, 34]. A scoping review is also important for advancing intensive knowledge synthesis, particularly for increasing the efficiency and quality of future evidence synthesis and providing insights for subsequent research directions [35].

The aim of the present scoping review is to systematically examine and summarize the nature and knowledge gaps of existing data about policies, services, interventions, and related research aimed at improving the health and function of older people based on life course approaches or frameworks. In detail, the scoping review consisted of several stages: a literature search, study selection, data charting and summarizing, and data synthesis, as recommended by previous studies [33, 34, 36].

Regarding the literature search, the papers were retrieved from online databases that are representative of health, social, and economic sciences. The databases were PubMed, Web of Science, and Google Scholar. Literature searching was accomplished using a combination of keywords related to “life course”, “aging”, “policy/service/intervention”, and “function/disability”. Details of the search strategy are described below. We used EndNote X9 application to remove duplicates prior to a manual de-duplication process.
During the study selection, we screened the literature by executing a title-abstract screening and then full-text screening. We invited several reviewers whom are physical therapists with expertise mainly in the health of geriatrics and/or maternity and early life, of adolescents, of young adults, and of working-age adults. Prior to the title-abstract screening by five reviewers (A, B, C, D, E), a trial was done by C with a WHO Technical Officer as the evaluator. This trial was important to assure the inclusion and exclusion criteria were applicable and explicit. Later, the result of the trial was discussed among the five reviewers to ensure the team shared common understanding when deciding whether an article should be included or excluded. After adjustments to several reviewers’ suggestions and revisions, the final inclusion and exclusion criteria were decided (Table 1). Finally, the reviewers were gathered for a one-day training. They examined the included articles individually. However, group discussions were held during and after the screening process to evaluate each member’s conclusion, particularly when there was uncertainty about the selected papers.

Consecutively, we proceeded to a full-text screening done by eight reviewers (B, D, E, F, G, H, I, K). We asked more reviewers for the full-text screening to fit in the time schedule. Moreover, different reviewers provided confirmation of the included studies, because they screened the articles randomly and made judgement about whether to include the study or not. For reviewers B, D, and E, who also did the title-abstract screening, they worked on articles other than their title-abstract screened articles. All reviewers were asked to make judgement about which article should be included and to fill the data extraction form to gain necessary data for the data charting and summarizing process. The trial of the data extraction form had been performed by C with the WHO Technical Officer as the evaluator. Following the trial process, the summary was discussed among the eight reviewers to ensure the team shared the same understanding in deciding whether an article should be included or excluded and how to fill the form. After adjustments to several reviewers’ suggestions, reviewer C completed the final version of the data extraction form. Finally, we asked the reviewers to follow a one-day training prior to the full-text screening. The research team and reviewers conducted a group discussion.
following the full-text screening to evaluate each member’s conclusion, particularly when there was uncertainty about selected papers.

The reviewers were requested to do the data extraction using the original extraction form developed by previous studies [35, 37-39] and the present study objective. The reviewers appraised the study’s methodology using Mixed Methods Appraisal Tool 2018 (MMAT 2018) [40-44], which helped us determine the study’s quality even though the scoping review did not obligate this process. Moreover, this kind of appraisal tool facilitated the reviewers to examine a broad range of the study design, because the present study did not set exclusion criteria for a certain study design. In brief, MMAT 2018 was used to appraise empirical studies only and could not be used to assess non-empirical articles such as review or theoretical articles. MMAT 2018 covered five study designs: qualitative, quantitative randomized controlled trials, quantitative non-randomized, quantitative descriptive, and mixed-methods. Reviewers were to choose the appropriate category of studies, because each study design has different quality criteria. The response to each quality criterion was a point (1) for the presence, null (0) for the absence, or not applicable (NA) if the criterion did not match the article’s study design. We did not set a high or low quality as final judgement, since the tool’s manual discouraged this approach. Finally, the reviewers decided whether the study was included or not for further analysis using the inclusion and exclusion criteria.

Finally, we did data charting and data summarizing using the extraction form, in which information from selected papers was extracted and subsequently composed into a summary. Two reviewers (B and C) re-checked the form after all reviewers completed it to make sure the included paper satisfied the inclusion-exclusion criteria and to confirm missing data and questionable content. Results from the data extraction are explained and synthesised narratively in the Results and Discussion sections.
A search for peer-reviewed journals was executed using academic databases (PubMed and Web of Science) and grey literature (Google Scholar, snowball sampling the references, and experts’ recommendation) between June 2019 and December 2019. We considered Google Scholar as necessary, because we aimed to expand the search to wider and more general sources. We did snowball sampling by hand-searching the papers and citations that were assumed missed during the electronic searches. Snowball sampling also included websites of international organizations recommended by known experts in order to identify documents that focus on life-course approaches and/or UHC frameworks.

Table 1. Inclusion and exclusion criteria of the scoping review

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing papers with qualitative/quantitative analysis of the effect of a policy/service/intervention based on a life-course approach to achieve healthy aging populations (healthy aging here refers to any improved elderly health outcome)</td>
</tr>
<tr>
<td>2. Existing qualitative/quantitative papers on regional policies, programs, or interventions using life-course approaches to achieve healthy aging communities</td>
</tr>
<tr>
<td>3. Existing quantitative studies on life-course concepts for particular life aspects (i.e., health, social, etc.) with healthy aging or improving older (50 years or older) people’s health as an outcome</td>
</tr>
<tr>
<td>4. Existing quantitative studies focusing only on older people so long as they examine the effects of a life course factor on older people’s health as a future outcome. In other words, studies that look at the impact of an older person’s recent health on health outcomes over a short time (1-5 years)</td>
</tr>
<tr>
<td>5. Existing studies that are cross-sectional in design but also mention the impact of life-course factors and healthy aging as an outcome</td>
</tr>
<tr>
<td>6. Papers written in English</td>
</tr>
<tr>
<td>7. Studies published from 2009 to present (2019)</td>
</tr>
<tr>
<td>8. Studies that consider general populations or general diseases (communicable and noncommunicable diseases)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Theoretical papers that discuss life course approaches and healthy aging without any empirical analysis</td>
</tr>
<tr>
<td>2. Reports on current problems without consideration of later life effects on older people’s health</td>
</tr>
<tr>
<td>3. Articles that mentioned “life course”/“healthy aging” less than five times</td>
</tr>
<tr>
<td>4. Articles in which the application of a life course as an approach or healthy aging as a goal in policy/program/intervention was not clear</td>
</tr>
<tr>
<td>5. Interventions or experiments on non-humans</td>
</tr>
<tr>
<td>6. Incomplete or inaccessible papers such as editorials, comments, databases, etc.</td>
</tr>
<tr>
<td>7. Reports on life-course measurements or analysis techniques</td>
</tr>
</tbody>
</table>
Table 2. Search terms

<table>
<thead>
<tr>
<th>Database</th>
<th>Word combination</th>
<th>Special database option</th>
</tr>
</thead>
</table>
| **PubMed**          | ("life course" OR "early life")
                     | (older OR elder* OR senior OR geriatric*)
                     | (intervention OR policy OR program OR action OR plan OR agenda OR “health service for the aged” OR “health service”)
                     | (“healthy aging” OR “functional ability” OR “activit* of daily living” OR “limitat* of activity” OR dysfunction* OR disabilit*)
                     | Only research on humans
                     | Language English
                     | Timespan 2009-2019                                                                                                                                                |
| **Web of Science**  | TS=(intervention OR policy OR program OR action OR plan OR agenda OR “health service*” OR “social service*” NEAR/1 (“life course” OR “later life” OR “healthy aging” OR “healthy age*”))
                     | AND                                                                                                                                                    |
                     | TS=(“life course” OR “life course NEAR/0 (approach* OR perspective* OR stud* OR theory*)”)
                     | AND                                                                                                                                                |
                     | TS=("functional ability" OR “activit* of daily living” OR “limitat* of activity” OR dysfunction* OR disabilit*)
                     | AND                                                                                                                                                |
                     | TS=(“older people” OR elder* OR age* OR agi* OR senior OR geriatric*)
                     | Special database option:                                                                                                                                            |
                     | Language English
                     | Articles only                                                                                                                                             |
                     | Timespan 2009-2019                                                                                                                                                |
| **Google Scholar**  | policy intervention "life course" "healthy aging" "health service" "social service" "functional ability" OR action OR program OR agenda OR "activity of daily living" OR "limitation of activity" OR dysfunction OR disability OR older "life course"
                     | Special database option:                                                                                                                                            |
                     | Language English                                                                                                                                             |
Results

Conceptual Framework

The first article reviewed [25] demonstrated a framework that conceptualized recent global monitoring through the life course. The framework consisted of financial risk protection; health impact through the life course; health service coverage; health system resources, capacity, and performance; and social determinants of health. However, there was no further explanation provided. The second article [23] presented a framework of how a life course links to health and the implication of its implementation. The framework was built from several components such as the life stage, individual health outcomes, social and environmental determinants of health, and principles in practice for the realization of rights. The framework of the life course approach to health emphasized functional ability as the main outcome. Functional ability was represented as individual or population well-being by considering internal and external stimuli. The third article [28] demonstrated several conceptual models of the life course approach to health; they were the critical period model, cumulative model, trigger model and, the latest model, the pathway model. In general, all models considered a person’s lifespan, exposure, later life health outcomes, and the role of other factors outside health factors such as socioeconomic status and environment. The fourth article [29] presented a framework of the trajectory of health and well-being across the life course by considering the life stage, accumulating damage across the lifespan, resilience, and peak capacity. It emphasized the maintenance of peak capacity and minimization of early decline. The fifth article [32] proposed a life course health development framework. The framework was more
complex compared to other frameworks and used an input-process-output model. It consisted of four
related principles: the multiple contexts of health development, such as physical, social, family, and
other environments; the design and process of health development; the mechanism responsible for
variations in health development trajectories; and the integration of multiple time frames across a
lifespan. The framework depicted how biological factors and environments transform a person’s
functional ability across one’s life course.

From the five frameworks, we saw consistency in several key words: life stage (from
birth until older age), functional ability, and factors (health, socioeconomic, and environment).
Predominantly, the five studies agreed that a healthy individual is not necessarily free from disease
and that we should examine the variation of their functional ability to perform daily life; every life
stage is affected by the past and will modify future conditions. The point, they continued, is to maintain
functional ability by considering health, socioeconomic, and environment factors. Those factors may
act either as risk factors or protective factors to later health outcomes (future). The current study
focused on aging populations, thus, we use the term healthy aging as a goal of later health outcomes.
Healthy aging is prescribed as the process of developing and maintaining the functional ability for the
well-being of older people [5].

We adapted the basic structure of the framework described by Kuruvilla et al. [23]. We
depicted health as an integrated system of multiple factors across a lifespan. We emphasized the
importance of maintaining functional ability in order to grow old with good well-being. With this
framework, we asserted that service coverage monitoring should consider health as an integrated
system of multiple factors and time frames instead of a fragmented assessment of disease-related
factors at one life stage. We then investigated how far this effort has been applied to
policies/services/interventions and related research based on life course approaches or frameworks at
improving the health and function of older people. Later, we explain how the literature review will
help us find the answer.
Figure 1. The conceptual framework of the life course approach to achieve healthy aging

The curved solid line depicts an individual’s functional ability during common aging, and the curved dotted line depicts the maintenance of functional ability. The vertical solid line depicts a comparison of incomplete exposures (i.e., environmental and socioeconomic exposures only) for an individual, while the vertical dotted line considers all exposures. We hypothesized that consideration of all exposures more accurately represents the individual’s functional ability across the lifespan. The black circles and squares depict the integration and accumulative effect of each life stage, respectively.

Literature Review

Our study retrieved 514 articles. After removing duplicates and title/abstract screening, 175 full-text articles were retrieved for further examination. Although our study objective aimed to investigate the nature of existing policies/services/interventions on life course approaches to healthy aging, we obtained a limited number of eligible articles. We expanded our inclusion criteria to epidemiological research on the life course in healthy aging. To be easily understood and interpreted, we divided those 175 full-text articles into policy findings (n=18) and epidemiological findings (n=157). After the full-
text screening, we included 84 articles: 9 articles on policy findings and 75 articles on epidemiology findings (Figure 2).

Studies identified (n= 514)

Duplicates removed (n= 33)

Studies screened (n= 481)

Studies excluded after title and abstract screening
Not suitable content (n=306)

Full-text articles assessed (n=175)

Snowball searching and website (n=0)

Full-text articles excluded (n=91)

Studies included in data extraction (n=84)
Figure 2. The inclusion paper screening process

Policy findings

During the full-text screening, we examined 18 articles that discussed policies/services/interventions in the life course for healthy aging. Nine articles in total were excluded. Six of these articles either mentioned “life course”/“healthy aging” less than five times or the application of a life course as an approach and healthy aging as a goal in policy/service/intervention was not clear. The other three articles were limited to addressing specific groups with certain conditions such as a dietician workforce, older people with intellectual and developmental disabilities, and disabled older people. The nine studies that we did include demonstrated policies/services/interventions with a life course approach could enhance well-being at late life. All the included studies were delivered as a narrative review. Unfortunately, MMAT 2018 could not assess the study presented as a review, therefore, we could not assess the study’s quality.

The majority of articles supported our conceptual framework by promoting life course approaches implicitly. They did not directly introduce a life course approach, but they explained how each life stage matters to healthy aging. Six articles suggested certain health services including integrated health care (Table 3, row 1) [45], vaccines (Table 3, rows 5,6,7) [46-48], aging-friendly hospitals and health services (Table 3, row 8) [49], and person centred trauma informed (PCTI)-based health services (Table 3, row 9) [50]. In addition, four studies underlined the importance of socio-economic conditions and environmental factors such as where the individual was born, lives, works, and aged along with individual health (Table 3, rows 2,3,8,9) [49-52]. However, no study identified specific protective exposures that might contribute to healthy aging. Furthermore, few of the studies comprehensively explained a measurable standard to define whether one population or individual could be categorized as healthy aging or not, and only a small number introduced quality of life (QoL), healthy life years,
life expectancy, frailty (Table 3, row 3) [52] and functional ability (Table 3, row 4) [23] as measurable outcomes of healthy aging.

Furthermore, few studies mentioned policies in or related to LMICs (n=3) (Table 3, rows 1,4,5) [23, 45, 46] and only gave brief implementation of those policies in LIMCs setting. Only one of these studies discussed strategies for a life course approach to immunization in LMICs (several countries in Latin America) comprehensively [46]. Therefore, we have limited data to review feasible and applicable policies in LMICs setting. Most studies discussed strategies or on-going programs from high-income countries such as Taiwan (Table 3, rows 8) [49], the United States (Table 3, rows 2,6,9) [47, 50, 51], and the European Union (Table 3, row 3) [52]. The last study did not mention any specific geographical area [48].

The nine studies also tended to describe policies/services/interventions with older populations as a target (Table 3, rows 1,5,7,8,9) [45, 46, 48-50] rather than extensively addressing each life stage (Table 3, rows 2,3,4,6) [23, 47, 51, 52].

Based on the focus of the present study, we analysed three main topics among the included policy-related articles. First are articles that emphasized the importance of integrated health care in order to achieve a healthy aging population (Table 3, rows 1-4) [23, 45, 51, 52]. “Integrated health care” has several definitions. Two studies described integrated health care as delivering health care through integrated up-to-down levels, such as the macro level (policy level) and micro level (clinical or intervention level). Patient needs were placed at the centre of care, therefore, this model emphasized integration at the level of clinical care (Table 3, rows 1, 4) [23, 45]. The two other studies described integrated health care as a wide scope system that included the integration of common clinical care and community-based health service [51, 52]. These studies also mentioned the importance of social and environmental aspects. Moreover, each study uses different terms to address integrated health care
such as “integrated health care” (Table 3, row 1) [45], “3.0 transformation” (Table 3, row 2) [51], “culture of health” (Table 3; 3) [52], and “life course approach” (Table 3, row 4) [23].

Another topic of the policy findings is life course immunization [46-48]. All papers on this topic agreed about the importance of expanding immunization programs from early life to later life including old age. In line with this attitude, they were concerned about infectious illnesses that could be prevented by currently available vaccines. Moreover, the articles also explained a link between infectious diseases and increasing rates of morbidity and mortality. In sum, by expanding immunization across a population’s lifespan, it is possible to combat communicable and noncommunicable diseases within aging populations.

The last two articles discuss age-friendly services (Table 3, row 8) [49] and trauma across one’s lifespan (Table 3, row 9) [50]. Age-friendly services underlined the importance for health care service delivery to consider older populations’ special needs and conditions. The paper also recommended that health promotion and disease prevention be widely available to every individual at every age in consideration of an age- and gender-appropriate basis. The article on trauma was a review outlining several United States federal government programs that assist elderly who experienced or may experience a traumatic event. The article defined trauma as a harmful experience either physically or mentally that may have lasting adverse effects on the individual. Nonetheless, this review focused on injury-based and interpersonal trauma.

Table 3. Characteristic of studies included on policy finding

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
<th>LMICs</th>
<th>Population target</th>
<th>Discussed policy</th>
<th>Life course aspect included</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>1</th>
<th>Organizing integrated health-care services to meet older people's needs</th>
<th>de Carvalho et al.</th>
<th>2017</th>
<th>Yes</th>
<th>Older population</th>
<th>The importance of integrated health care to achieve better health outcomes among older people</th>
<th>The main aim of integrated care for older people is not to manage disease or prolong life but is instead to optimize older people’s intrinsic capacity over their life course and, hence, ensure healthy aging.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Applying a 3.0 transformation framework to guide large-scale health system reform</td>
<td>Halfon et al.</td>
<td>2014</td>
<td>No</td>
<td>All ages</td>
<td>The 3.0 transformation framework (community integrated health system)</td>
<td>The 3.0 health system emphasizes not only activated patients but engaged communities and motivated populations focused on creating local conditions that support health over the life course.</td>
</tr>
<tr>
<td>3</td>
<td>Creating a Culture of Health in planning and implementing innovative strategies addressing non-communicable chronic diseases</td>
<td>Tziraki-Segal et al.</td>
<td>2019</td>
<td>No</td>
<td>All ages</td>
<td>Initiating a Commission on Social Determinants of Health (CSDH) based on salutogenesis theory</td>
<td>Any effort to improve population health should be seen beyond the health care system and consider the condition where individuals are born, live, work and age.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>A life-course approach to health: synergy with sustainable development goals</td>
<td>Kuruvilla et al.</td>
<td>2017</td>
<td>Yes</td>
<td>All ages</td>
<td>A paradigm shift in health and development policies and programmes with a life course approach to health</td>
<td>A life course approach to health optimizes the functional ability of individuals throughout life, enables well-being and realization of rights, and recognizes the critical interdependence of individual,</td>
</tr>
<tr>
<td></td>
<td>Studies</td>
<td>Year</td>
<td>Populations</td>
<td>Goals of life-course immunizations</td>
<td>Findings and implications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td>-----------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Latin American Adult Immunisation Advocacy Summit: Overcoming regional barriers to adult vaccination</td>
<td>2018</td>
<td>Adult and older populations</td>
<td>Adult and elderly vaccinations</td>
<td>A life course approach rarely extends into middle and older ages, and most citizens are unaware of the benefits of vaccines against common, yet life-threatening infections, and the ultimate impact that vaccinations can have on healthy aging.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Challenges in adult vaccination</td>
<td>2018</td>
<td>All ages</td>
<td>Vaccine policies for all age populations</td>
<td>The goals of life-course immunizations include more than simply preventing...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Findings, conclusions and implications should not be interpreted as endorsed by WHO.

disease, but also include quality of life issues including productivity and independent living across an individual’s lifespan.

<table>
<thead>
<tr>
<th></th>
<th>Report of the ad-hoc consultation on aging and immunization for a future WHO research agenda online-course immunization</th>
<th>Thomas-Crusells, McElhaney, and Aguado</th>
<th>2012</th>
<th>No</th>
<th>Older populations</th>
<th>The report explained about the importance of vaccines against infectious diseases in the elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Since the immune system ages, trying to protect people later in life against certain pathogens may not be ideal. New vaccination schedules beginning from childhood and continue into adulthood (e.g., booster doses) and monitoring how immunity induced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20
Findings, conclusions and implications should not be interpreted as endorsed by WHO.

| 8 | Towards age-friendly hospitals and health services | Chiou and Chen | 2009 | No | Older populations | Age-friendly hospitals and health services based on WHO age-friendly principles. One approach has been done by Taiwan’s framework of age-friendly hospitals | An age- and gender-appropriate needs assessment for health promotion and disease prevention is provided to every person at every age beginning from first contact. In this way, health promotion can be started as early as possible so that function can be maintained at the age by these vaccines evolves as people age may be needed. This study bases its analysis on the concept of “life course vaccination”. |
| No | Trauma Causes by Injury or Abuse in Late Life: Experiences, Impacts, and the Federal Response | Iyengar et al. | 2019 | No | Older populations | Represents a collaborative effort among federal departments with a stake in elder justice to identify gaps, make recommendations, and coordinate activities that serve older adults who experienced or may experience a traumatic event | Knowing that trauma can occur in anyone’s life at any time throughout the life course and can have significant and lasting impacts on its victims and their families, it is essential that a broad spectrum of community-based organizations serving older adults have the competence and support to deliver PCTI (person-centered trauma-
Findings, conclusions and implications should not be interpreted as endorsed by WHO.

<table>
<thead>
<tr>
<th>Epidemiological finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the full-text screening, we categorized 157 articles into the epidemiological finding group. Those papers discussed various exposures throughout the subject’s lifespan that affect healthy aging adversely or favourably. We excluded 82 articles because they were inaccessible (n=5), examined a life course measurement/analysis technique (n=4), dissertations (n=5), addressed specific groups with certain conditions (n=12) such as specific ethnic or specific morbidity groups, were gene/bio-molecular studies (n=5), had no discussion about achieving healthy aging (n=9), had no discussion about the life course (n=17), examined healthy aging in younger populations (n=8), or were qualitative studies (n=17). We included articles that described older people’s conditions as outcomes after confirming they explained how exposures at earlier life stages have correlation or causal effects on healthy aging. As a result, we included 75 eligible articles. The study designs used by the included articles were varied: cross-sectional (n=14), longitudinal (n=58), randomized-controlled (n=2), and exploratory (n=1). The study populations were mostly older populations. However, some studies included a wide age range of populations in cross-sectional studies, for example 16 to 99 years old [53]. In the longitudinal studies, the baseline age varied from early life (i.e. 11 years old) or late adulthood (i.e. 45 years old) to the follow-up age at late life (i.e. 73 years old) [54, 55]. The size of the populations also varied from 35 to 67 290 subjects. The mean MMAT 2018 score of the 75 articles was 4.3 out of 5, which shows most of the papers provide substantial and clear information regarding their study design and that the methodological standard among and within the papers was met. Therefore, we could interpret and use the data for</td>
</tr>
</tbody>
</table>
further qualitative analysis. However, we could not qualify the study’s quality into an ordinal standard, such as low or high quality, as suggested by the MMAT 2018 guidelines.

Overall, few studies mentioned or reported LMICs (n=14), and most studies discussed or were delivered from high-income countries (n=61).

Referring to our conceptual framework, we concluded that healthy aging can be achieved by maximizing an individual’s health, socio-economic, and environmental conditions. The included studies mentioned those factors as exposures, covariates, or other variables except outcome. Due to the heterogeneity of the data, we decided to analyse these factors as three big groups: health exposures, socio-economic exposures, and environmental exposures. The majority of studies considered both health and socio-economic aspects across a person’s life (n=60). For example, one study considered the education level and employment status (socio-economic exposures) as demographic characteristics together with self-reported long-term illnesses (health exposure) [56]. On the other hand, few added environmental aspects to the health and socioeconomic aspects (n=14). For example, one discussed early life health, socio-economic conditions (health and socio-economic exposures), and late-life residential location (environmental exposure) to examine correlations with late-life loneliness [57].

Considering our review objective about achieving healthy aging, we examined the outcomes that may represent the healthy aging condition. However, the term “healthy aging” itself was broad and general so that it was easily analysed and understood. Therefore, we divided the measurable outcomes from the studies into six healthy aging domains: (i) general health, (ii) locomotor/physical capabilities, (iii) cognitive functions, (iv) sensory functions, (v) psychological conditions, and (vi) vitality/metabolic functions [6, 58, 59]. Several studies investigated more than one healthy aging domain. The list of healthy aging domains, measurable outcomes, and number of papers are shown in Table 4.

Table 4. The summary of healthy aging domains
<table>
<thead>
<tr>
<th>Domain</th>
<th>Outcome</th>
<th>Number of papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General health</td>
<td>Self-rated health; Mortality; Later life health status; Life course trajectories (marriage, fertility, employment); Life expectancy; Life expectancy with disease; Successful aging indicator; Active aging; Active and healthy aging (AHA); Productive aging; Well-being; Allostatic load; Survival rate; Frailty risk; Health trajectories; Oral health; Health profile indicator; Healthcare utilization</td>
<td>n=29 (23+6)</td>
</tr>
</tbody>
</table>
### 2. Locomotor/physical capabilities

| Functional ability; Functional limitation; ADL; Grip strength; Physical activity; Physical function; Physical performance and strength; Physical fitness; Disability |
|---|---|---|
| n=26 |

### 3. Cognitive functions

| Cognitive performance; Cognitive function; Cognitive transition; Cognitive dysfunction; Brain structure; Fluid cognition; Dementia |
|---|---|---|
| n=13 (12+1) |

### 4. Sensory functions

<table>
<thead>
<tr>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=0</td>
</tr>
</tbody>
</table>

### 5. Psychological conditions

| Loneliness; Quality of Life (QoL); Depression; Anxiety; Mental health; Social support |
|---|---|---|
| n=11 (9+2) |
6. Vitality/metabolic functions | Noncommunicable diseases; Brain burden of cerebral small vessel disease (cSVD); Abdominal obesity; Diet behaviour; Pain | n=5

We describe the characteristics of the included studies in supplementary file 1.

Discussion

Main findings

From our scoping review, we have made a number of main findings: (i) articles about how life course approaches can enhance older people’s well-being were delivered either as reviews of policies/services/interventions or epidemiological studies, (ii) both policy and epidemiological findings supported our conceptual framework in that to achieve healthy aging, we should consider an individual’s health, socio-economic, and environmental conditions across his/her lifespan, (iii) communicable and noncommunicable diseases might co-exist, (iv) policy and epidemiological findings mostly addressed populations at early life (infant and children) or late life (older people) and rarely mentioned mid-life (adolescence and working age), suggesting an imbalanced investigation of the population life course, (v) there are six domains and various measurable outcomes that can used to represent healthy aging, and (vi) there are few studies on policy implementation or epidemiological studies on LMICs.

Comparing recent service coverage monitoring systems
From the conceptual framework and literature review, we recognized the well-being of aging populations does not solely depend on the present situation and is influenced by the level of peak function gained in earlier life [30]. The level of peak function reflects the accumulation of strengths and deficits across the life course [5]. Throughout our life cycle, there are critical periods and life transitions. Critical periods are limited time windows when exposure may result in long-term effects on the individual and are unlikely modifiable in later life [60]. For example, untreated or poorly treated cataracts before an infant reaches his/her 18 month can alter the person’s vision significantly, but not so at older age. Moreover, the first decade of childhood is a critical period of neuronal vulnerability, while late life has benefited by the maturity of neuronal connections [32].

Life transitions are a series of biological, psychological, and social transitions that individuals experience during their lives. Those transitions could adversely or beneficially impact future health, and their effects are relatively greater than other times. For example, entering or leaving the workforce can lead to different stress levels, and how those levels are managed will drive the individual to different functional trajectories. Both critical periods and life transitions happen multiple times across a lifespan and account for important variations in aged people. Importantly, for some interventions to be effective, they must be delivered at the early stages of life [32].

With this understanding, we note that interventions and monitoring throughout life cannot be disregarded in efforts for the preservation of health among aging populations. To ensure every person has access to decent health services, especially in aging population in LMICs, a comprehensive monitoring system is needed [13, 61]. However, as we explain below, recent UHC is not capturing or representing whole populations.

Recent UHC used monitoring indicators that are focused on early life (Table 4, indicator numbers 2-4) and neglected indicators for adolescent, worker, and older populations. Although the early life condition has an important effect on the later life condition [54, 55, 57, 62-68],
early adulthood is also important for later life outcomes in LMIC populations. Early adulthood represents the critical time of the work environment related to a person’s career development and family formation [69]. Service coverage monitoring for older populations also deserves more attention in UHC. Regarding the fact there is an increasing number of older people in LMICs, maintaining the well-being of older people is crucial, because healthy older persons are a resource for society and the economy. Aging populations that require more healthcare will be challenge for any nation [49].

As populations age, LMICs face the double burden of communicable diseases and multiple noncommunicable diseases [23, 45, 51, 52]. One previous study even mentioned a triple burden by including foreseeable pandemics [8]. As mentioned by one report, communicable and noncommunicable diseases are interrelated [70]. Infection and deficiencies during a mother’s pregnancy, e.g. malaria and anaemia, may contribute to the risk of metabolic disease in the offspring’s adult life [71]. Furthermore, neglected or prolonged infectious diseases could be the origin of noncommunicable diseases. For example, hepatitis B and C infections are strongly associated with liver cancer, which has a high incidence in LMICs. Conversely, noncommunicable disease, such as diabetes, might increase the risk of infectious disease like tuberculosis [72]. Finally, both types of diseases could coexist in a person, complicating treatment.

From our point of view, recent service coverage monitoring already includes communicable diseases (Table 4, indicator numbers 5-7) and noncommunicable diseases (Table 4, indicator numbers 9-12). However, the complexity of health among aging populations in the future cannot be conceptualized as disease-based only [7]. Health systems should recognize a person functioning across the lifespan and the total sum of their health rather than discrete disease categories [45, 73].

Lastly, our scoping review implied that healthy lives can be achieved if we consider socioeconomic and environmental aspects. By tracking multiple aspects beyond health itself,
governments can evaluate, strengthen and promote future strategies for achieving healthy populations [46]. For example, facilitating social programs (policy 3) or promoting age-friendly health settings [49]. Socioeconomic and environmental factors, such as adverse childhood experiences (ACEs), early life socioeconomic status, or area of residence, may have consequences along the individual’s lifespan [62, 74-78]. Thus, we concluded monitoring these factors is crucial for achieving healthy aging.

Recent UHC monitoring systems have investigated socioeconomic aspects only limitedly as separate indicators for financial protection. However, those indicators only illustrated the individual’s recent condition and did not consider long-term or across lifespan aspects such as gender, education, and race [56, 79-81]. Additionally, the indicators do not consider social aspects such as social participation [82]. Lastly, environmental exposure has been included in recent UHC monitoring indicators including living conditions (Table 4, indicator 8) and access to the health service (Table 4, indicators 13 and 15).

Table 4. Tracer indicators of recent service coverage monitoring

<table>
<thead>
<tr>
<th>16 tracer indicators to monitor progress towards UHC on coverage of health services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Family planning</td>
</tr>
<tr>
<td>2. Pregnancy and delivery care</td>
</tr>
<tr>
<td>3. Child immunization</td>
</tr>
<tr>
<td>4. Child treatment</td>
</tr>
<tr>
<td>5. Tuberculosis treatment</td>
</tr>
<tr>
<td>6. HIV treatment</td>
</tr>
<tr>
<td>7. Malaria prevention</td>
</tr>
<tr>
<td>8. Water and sanitation</td>
</tr>
<tr>
<td>10. Management of diabetes</td>
</tr>
</tbody>
</table>
Findings, conclusions and implications should not be interpreted as endorsed by WHO.

| 11. | Cancer detection and treatment |
| 12. | Tobacco control |
| 13. | Hospital access |
| 14. | Health worker density |
| 15. | Access to essential medicine |
| 16. | Health security |

**Future directions: a life course approach for service coverage implementation and monitoring**

Based on recent findings, we identified key ways in which a life course approach can improve service coverage implementation and monitoring. As suggested by the WHO 2019 Global Monitoring Report on UHC [83], using these key points, we urge countries to design their healthcare service and later make adjustments to the monitoring systems. The key points are (a) a healthcare system that is integrated at the macro (i.e., policy or sector), meso (i.e., organizational or professional), and micro (i.e., clinical or interventional) levels and simultaneously considers health, socioeconomic, and environment factors, (b) a healthcare system that considers the unique features and needs of each life stage and how each life stage is connected, and (c) a healthcare system that redefines health as a “capacity to live actively and independently” instead of a “disease-free condition”. Epidemiological studies indicate six domains that could be used to define healthy aging: (1) general health, (2) locomotor/physical capabilities, (3) cognitive functions, (4) sensory functions, (5) psychological conditions, and (6) vitality/metabolism function.

We propose a conceptual framework of a life course approach on service coverage monitoring as an input-process-output-outcome concept (Figure 3). Input would be the key points of the life course approach based on recent policies/services/programs. Process monitors and evaluates
the policies/services/programs for improvement. Through this system, a healthy aging population, as represented by the six domains, is expected.

Figure 3. The conceptual framework of the life course approach on service coverage monitoring as an input-process-output-outcome concept.

Recent work has not proposed specific policies/services/programs or introduced indicators for a life course approach to improve service coverage and monitoring due to limited information from literature review. Future work and effort are needed to translate recent conceptual frameworks and findings of the literature review into action. Because any life course approach is complex and multidimensional, a collaborative and multiorganizational effort is necessary.

One study identified maternal and child health (MCH) life course indicators [84]. That study proposed assessing, monitoring, and evaluating the application of life course principles to public health. It also proposed a conceptual framework and a set of 59 indicators that showed overlap with existing public health measures. Thus, a life course approach does not mean starting from scratch.

Three other studies informed the importance of vaccination programs for adult and older populations [46-48]. Vaccinations are renowned as one of the most effective public health services in history [46]. Preventing disease through vaccinations also means protecting older people through herd immunity. To achieve healthy aging, we should expand vaccinations beyond children.
and to adult and older people. At present, there is low coverage of adult vaccination, which means a higher risk and burden in vaccine-preventable diseases.

To implement a life-course approach in LMICs, we realized several challenges. First, LMICs have limited data, especially on noncommunicable diseases [10, 83]. Second, integrated care for older people is sparse [45]. Finally, financial constraints are still obstacles for LMICs to inclusively provide health services beyond clinical and curative interventions [10].

**Strengths and limitations**

The present study provided an overview of the available research to identify the nature and knowledge gaps about policies, services, interventions and related research (i.e. epidemiological articles) aimed at improving the health and function of older people based on a life course approach or framework. We further fit it into a conceptual framework to compare with UHC monitoring systems. This work followed a systematic and robust process and also involved consulting experts from Thailand and Indonesia on LMIC efforts and experiences.

The major limitation of the present study is that we limit our discussion to service coverage monitoring, but financial protection should also be considered. We therefore encourage future study to investigate life course approaches on financial protection. Our literature review also has a few weaknesses. Alternative media, such as dissertations and books, were not included in the literature search, although we did include some books from snowball sampling and experts’ recommendations. We decided to include mostly published articles, since policy/services/intervention discussions were mainly available on this database. We also used limited string and word combinations, thus, we may have missed some relevant papers. Nonetheless, this method was needed to maintain the focus of our content. Also, most studies we retrieved were from high-income country settings, even though our initial objective was to address LMICs. Our scoping review was also assessed individually, instead of using two investigators to cross-check a paper. However, we conducted a group discussion
to evaluate each investigator’s results and two coordinators cross-checked the inclusion and exclusion criteria, missing data, and questionable content of the extracted data.

Conclusion

The present study suggested a life course approach may be useful to reforming health systems in LMICs with aging populations in order to achieve UHC. We proposed a conceptual framework of a life course approach to achieve healthy aging. This conceptual framework facilitated us to conduct a literature review and interpret the results. During the literature review, we investigated previous studies on life course approaches for health policies/services/programs and suggested possible areas for future research in service coverage monitoring. We combined the conceptual framework and results of the literature review to examine recent service coverage monitoring and suggest future efforts to improve monitoring systems. Using key points of the life course and healthy aging as outcomes, this study conceptualised service coverage monitoring using a life course approach.

For future study, we highly recommended to transform recent conceptual frameworks and findings into applicable action. A future study that includes financial protection is also needed.
References:

8. Bollyky, T.J., et al., Lower-income countries that face the most rapid shift in noncommunicable disease burden are also the least prepared. Health affairs, 2017. 36(11): p. 1866-1875.


29. Jacob, C.M., et al., *What quantitative and qualitative methods have been developed to measure the implementation of a life-course approach in public health policies at the national level?* 2019.


WHO Centre for Health Development (WHO Kobe Centre - WKC) Working Paper (#K18021)
Findings, conclusions and implications should not be interpreted as endorsed by WHO.


