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HEALTH EVIDENCE NETWORK SYNTHESIS REPORT **63**

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?

Chandni Maria Jacob | Cyrus Cooper | Janis Baird | Mark Hanson

The Health Evidence Network

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HEN and the Evidence for health and well-being in context project: enhancing Health 2020 monitoring and reporting

The Evidence for health and well-being in context project was initiated at the WHO Regional Office for Europe in response to Members States' consideration of Health 2020, the European policy framework for health and well-being. Health 2020 includes a number of promising values-based health concepts that are difficult to measure and report on. In response to this challenge, the WHO Regional Office for Europe convened an expert group to investigate ways of enhancing Health 2020 monitoring and reporting. The first meeting of the Expert Group on Enhancing Health 2020 Monitoring and Reporting was convened by the WHO Regional Office for Europe on 1–2 September 2016. The project operates under the umbrella of the WHO European Health Information Initiative (EHII), a multimember WHO network that seeks to improve and harmonize information for health among the 53 Member States of the WHO European Region.

The Expert Group recommended the commission of this HEN synthesis report examining the quantitative and qualitative methods developed to measure implementation of a life-course approach in public health policies at a national level. Two related previously published HEN synthesis reports related to Health 2020 values-based concepts were also recommended by the Expert Group: HEN 59 on community empowerment and HEN 60 on community resilience.

Health Evidence Network synthesis report 63

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?

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Abstract

A life-course approach to health and well-being has become a pillar in health policy-making; for example, Member States of the WHO European Region in the 2015 Minsk Declaration resolved to make greater use of a life-course approach in health policies. However, strategies for implementation of a life-course approach, and a plan for monitoring and evaluating this implementation, are lacking. This scoping review identified a lack of literature with a focus on measurement of the implementation of a life-course approach. The report provides suggestions from research on a life-course approach in public health interventions and national-level strategies that could aid policy-makers in developing a measurement framework. For example, Member States using a life-course approach in policy at a population level could report on existing interventions in key stages of the life-course using existing survey platforms and routinely collected quantitative data. Ideally, a monitoring and evaluation framework collecting data longitudinally across different life stages over time should be created for Member States.

Keywords

HEALTH PLAN IMPLEMENTATION, METHODS; HEALTH POLICY; QUALITY OF LIFE; LIFE STYLE; HEALTH STATUS INDICATORS; PUBLIC HEALTH

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ABBREVIATIONS

CINAHL	Cumulative Index to Nursing and Allied Health Literature
ECD	early childhood development
EU	European Union
IBSS	International Bibliography of the Social Sciences
MCH	maternal and child health
NCD	noncommunicable disease
SDG	Sustainable Development Goal

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SUMMARY

The issue

Adult health and well-being are grounded in health and experiences in earlier stages of the life-course and are influenced by a range of cultural, socioeconomic, environmental and biological factors acting through the life-course. The acknowledgement that health is a dynamic continuum and not a set of isolated health states helps to explain disease patterns, including health inequalities, across populations and over time. There is also growing scientific evidence in support of a life-course approach. However, the complex, multifaceted and wide-ranging perspectives encompassed by the term life-course approach make measurement and evaluation of its implementation challenging. A life-course approach to health has become important in recent policy frameworks and health policy-making, with increasing formal and informal political commitment and momentum for adopting such an approach from Member States of the WHO Regional Office for Europe. Evidence is required to support development of a framework to measure and report on the implementation of a life-course approach in public health policy-making.

The synthesis question

To support decision-makers in shaping national and regional policies for implementation of a life-course approach, this report identifies relevant evidence on the measurement of the implementation of policies and programmes based on such an approach. It addresses the question: "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?"

Types of evidence

This report used a scoping review to examine academic and grey literature in English and Russian published from January 2007 to April 2018, with a focus on the WHO European Region but also considering worldwide literature and recommendations from key experts in the field. No documents relevant to the synthesis question were found in the search of documents in Russian. A total of 24 documents were considered that provided recommendations for measuring the implementation of policies and programmes based on a life-course approach.

Results

The practical application of life-course theory and research is relatively underdeveloped, with implementation mainly focused on particular disease conditions (e.g. noncommunicable disease (NCD)) or life stages (e.g. pregnancy, childhood or ageing). While countries have committed to using a life-course approach in health-related policies, there is a lack of detail in the documents identified on monitoring and evaluation plans or on a systematic way of measuring the implementation of a life-course approach. However, a lack of findings directly answering the synthesis question does not indicate that countries are not using a life-course approach.

Although the focus was on measurement strategies, certain documents have been included in the review that did not directly report on the measurement of implementation but rather evaluated the effectiveness of the implementation. The report could not identify a set of indicators to measure implementation of a life-course approach. Some studies were used as proxies to explore potential indicators and frameworks used in current policy and practice. Relevant details about strategies used to implement a life-course approach and the barriers and facilitators to implementation were extracted. Measurement methods were considered in three groups: conceptual frameworks; quantitative methods, including evaluation frameworks and indicator sets; and qualitative methods. Different strategies could be seen to be complementary, and a mixed methods approach, such as that used by Malta's Healthy Weight for Life strategy and Iceland's Welfare Watch programme, reflected the application of the broader conceptual framework recommended in the literature and its value for monitoring and evaluation. This approach enables implementation of a life-course approach to be linked to other strategies for public health and the use of existing indicator sets (surveys) and qualitative approaches.

Policy considerations

This report draws policy considerations from the best available evidence on implementation of a life-course approach in public health interventions and national-level strategies. While strategies for monitoring specific conditions exist, further research is needed to develop a valid, versatile, reliable and responsive framework to measure the implementation of a life-course approach for use at a policy level that can be translated to community-based and clinical programmes. Political commitment will be required to capitalize on a life-course approach

advanced by public health organizations within each country and to develop a plan for evaluation.

In developing measurement strategies, the following policy considerations are proposed:

- develop an implementation measurement framework or a life-course approach that aligns with existing monitoring frameworks (e.g. the Sustainable Development Goal (SDG) and national NCD strategies) and reflects horizontal linkages (multisectoral across policy sectors and interdisciplinary across research areas) as well as tracking intergenerational trajectories using longitudinal and time series data across different life stages;

- utilize existing commonly used data and data collection methods, as suggested in this report, and explore linking data across existing social, medical, educational and other systems;

- utilize the existing measures identified in this report and refer to them specifically as measures of a life-course approach;

- take into account features such as equity, resource realignment, impact, intergenerational wellness and the current scientific understanding of life-course health when selecting indicators for measuring a life-course approach;

- build on existing qualitative and mixed methods approaches and explore how to measure context-specific behavioural and psychosocial pathways influencing health and well-being across life stages; and

- promote life-course research by supporting health information producers and researchers in developing interdisciplinary longitudinal studies across the lifespan and across generations to determine the full scope of life-course influences, including using a common terminology for life-course concepts and developing a strategy for implementing a life-course approach in population, clinical and policy settings.

1. INTRODUCTION

1.1 Background

Health 2020, the WHO European policy framework for health and well-being, recognized a life-course approach as a fundamental organizing principle within health and health policy: priority area 1 is "investing in health through a life-course approach and empowering people" (1). Health 2020 has initiated a shift towards a values-based approach with the core ideals of "fairness, sustainability, quality, transparency, accountability, gender equality, dignity and the right to participate in decision-making". The 2030 Agenda for Sustainable Development in 2014 (2) also promoted commitment to health through the life-course in SDG 3, to "ensure healthy lives and promote well-being for all at all ages". Adopting a life-course approach becomes particularly pertinent with this shift towards a values-based approach, calling for the consideration of contextual factors and the lived experiences of communities and individuals. At the WHO European Ministerial Conference on the Life-course Approach in the Context of Health 2020, held at Minsk in 2015 (3), Member States signed a declaration in which they agreed that using a life-course approach was an essential step towards the implementation of Health 2020 (1) and the 2030 Agenda on Sustainable Development (2). Member States also agreed that a life-course approach should incorporate actions that are taken early, are appropriate to transitions in life and confer benefits to the whole population across the lifespan and to future generations. Implementing a life-course approach calls for a focus on a healthy start to life and targeting people during critical periods in their life-course, such as investing in childhood (4). The aim is to prevent disease and its risk factors at the earliest possible time, and to promote timely investments that would have a high rate of return for Member States (5).

1.1.1 A life-course approach

A life-course approach is a complex, multifaceted and wide-ranging umbrella process, making the measurement of its implementation challenging. Studies based on the life-course often view people's lives with a particular focus on a phase of life, or the connection between two or more phases or outcomes within one domain such as health or socioeconomic status (6). This gives rise to multifaceted concepts of elements and domains, for example the timing of particular transitions, their linkage to events and exposures in other life stages and their consequences (6). The approach also allows exploration of different levels of causation (societal,

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individual, biological) and helps to draw public health implications from them. Key elements within a life-course approach include an emphasis on time course, causation and a multisectoral/multidomain understanding of health and well-being.

Time is a crucial component of a life-course approach, both in terms of an individual's chronological age and the historical time, which influences population health. Changing environments influence an individual's risk for disease and response to treatment and prevention, and hence life-course explanations for health conditions are time and place dependent (7). Each individual will pass through a sociocultural sequence of age categories (gestation, infancy, childhood, adolescence, young adulthood and later adult life) (8). It is also clear that there is transgenerational transmission of risk for NCDs, which has led to a focus on ensuring optimum health from the embryonic period, and thus for parents in the preconception period (9). An individual will also have time-specific biological, behavioural, psychosocial and physical exposures that will impact on health and disease risk in later life (7,10,11). Both risk and protective factors are determinants of health outcomes and represent aspects of health development as functional trajectories (12), with the risk of many health conditions commencing in early development (13).

Causation over time is often examined using longitudinal cohorts to assess associations. The Dutch Hunger Winter families study (covering births in 1945–1946) was one of the first studies to examine how maternal undernutrition during pregnancy affected the subsequent health of the offspring in adulthood. Children born after the famine of 1944 to mothers undernourished during pregnancy had a lower glucose tolerance and an atherogenic blood lipid profile, which increased the risk for diabetes and heart disease in adulthood (14). Public health promotion programmes by national and international health agencies, therefore, often concentrate on life-course causation.

A multisectoral approach has been utilized predominantly in the context of NCD prevention strategies, such as improving nutrition during pregnancy. A socioecological model postulates that changes in individual outcomes are influenced both by individual-level factors (e.g. age or gender) and by interactions with the larger social, cultural, economic and environmental contexts in which individuals live. For example, the Report of the WHO Commission on Ending Childhood Obesity considered that obesity prevention and treatment required a whole-of-government approach in which policies across all sectors take health into account and avoid harmful health impacts (15).

1.1.2 Use of life-course approaches for health

Since the early 2000s, a life-course approach has become a powerful organizing framework for the study of health, determinants of health, disease and mortality and is now frequently considered as the leading theoretical platform for the study of patterns of lives as they unfold across time (10). Although a life-course approach in public health has been mainly applied in chronic disease epidemiology (16), the approach has wider applicability within the context of infectious diseases, reproductive health, ageing, general health and well-being, and reducing health inequalities (7,17,18). A life-course approach has helped in understanding that early developmental processes and environmental influences, including those acting before conception, can affect the peak capacity of health and well-being attained by an individual (19). In addition, the rate of decline in capacity for an individual is dependent not only on the current health status and influences but also on the level of peak capacity attained earlier in life. The aim of interventions using a life-course approach is to maintain for longer periods the peak function that is attained and also to minimize early decline. Fig. 1 shows the trajectory of health and well-being across the life-course, depicted in terms of function and resilience

Fig. 1. The trajectory of health and well-being across the life-course

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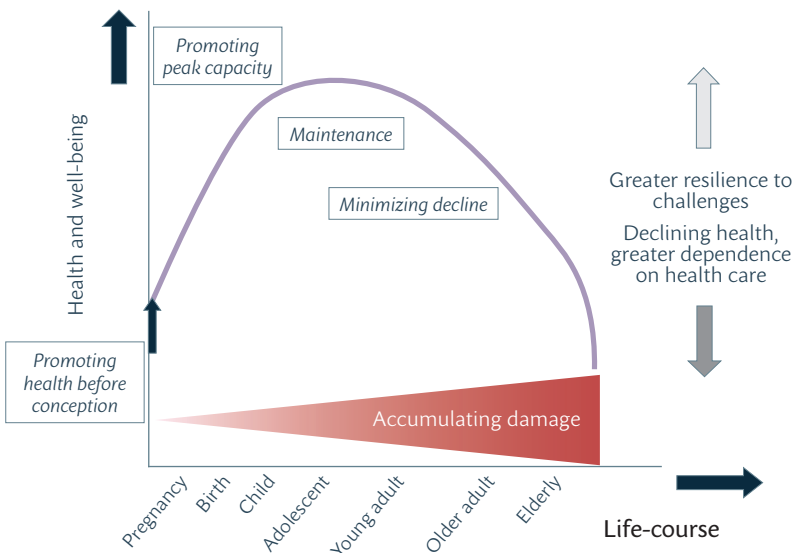
to challenges. Factors affecting life-course health operate even in the period before conception and influence the passage of health and well-being across generations. Peak function occurs in adolescence or young adulthood and declines thereafter through natural ageing processes and the accumulated damage from health challenges across the life-course. Declining health associated with reduction in resilience leads to greater dependence on health care and other support systems. The aim of interventions using a life-course approach is to promote the development of peak function and to maintain it for as long as possible and minimize its decline. The rate of decline is further influenced by factors such as resilience to challenges and socioeconomic context.

Adult health and mortality risk from NCDs are linked to both early life and adult lifestyle (20). SDG 3.4 aims by 2030 to "reduce by one third premature mortality from noncommunicable diseases through prevention and treatment and promote mental health and well-being" (2). A number of recent strategies and recommendations outline approaches across the life-course to tackle the burden of NCDs through reduction of exposure to risk factors. These include WHO's Global Status Report on Noncommunicable Diseases (21), the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030) (22) and the United Nations Political Declaration for the 2018 High-level Meeting on NCDs (5). The World Report on Ageing and Health (23) introduced the concept of intrinsic capacity and functional ability. Intrinsic capacity is defined as "the composite of all the physical and mental capacities that an individual can draw on", whereas an individual's functional ability is the interaction between the individual and the environment. The goal of healthy ageing is to build functional ability during the life-course and maintain it for as long as possible. The European Food and Nutrition Action Plan (24) also commits to promoting a life-course approach to aid the prevention and control of diet-related NCDs and malnutrition by addressing maternal nutritional status and health before and during pregnancy and continuing with good infant feeding practices, including promotion of breastfeeding.

Prevention of NCDs through interventions early in the life-course is also part of the report by the WHO Regional Office for Europe focusing on maternal nutrition to provide the best start in life and prevent diet-related NCDs (25). The report emphasized that adopting a life-course approach is not limited to taking a longitudinal perspective but also requires the acknowledgement that adult health and illness are grounded in health and experiences in previous stages of the life-course. It is essential to implement a life-course approach in policy, addressing maternal nutrition and health before and during pregnancy, followed by

appropriate newborn, infant and young child feeding practices through measures such as supporting breastfeeding and healthy weaning foods. These practices need to continue throughout childhood, adolescence and adult life into older age, incorporating measures for social, economic, environmental, biomedical and other relevant factors influencing health.

A whole-of-society and life-course perspective on the social determinants of health has been recommended to reduce inequalities in health, alleviate intergenerational transmission of risks and disadvantages, and improve overall quality of life (26,27). This requires intersectoral policy initiatives such as those based on the principle of universal health coverage, together with other forms of social services and social security (25,26,28). Health promotion and disease-prevention initiatives based on a life-course approach would need to target infants, children, adolescents and adults, which would require a major change in health delivery structures, with longitudinal integration of services over time (29,30).

1.1.3 Measuring implementation of a life-course approach

Interventions that attempt to have a life-course approach need to be tested to see whether those targeting one life stage are effective in modifying the outcome at subsequent stages. Few studies fulfil these criteria while explicitly naming their approach as a life-course approach. These predominantly involve interventions during fetal development, with outcomes measured later in life, for example associations between calcium supplementation in pregnancy and blood pressure in the offspring (29,31,32). Assessment of an intervention with a life-course approach requires follow-up over time, with the additional problems such as loss to follow-up and the effect of confounding factors occurring in the long period between exposure and outcome. While a number of frameworks/models have been conceived for analysis of a life-course approach (10), these tend to be complex as they take into account genetics, intrauterine environment, childhood health status and behavioural and environmental factors. Consequently, they are difficult to operationalize to support policy and practice and stakeholder engagement (33). Member States of the WHO European Region committed in the Minsk Declaration to developing national monitoring and evaluation frameworks to assess and report on well-being and quality of life across the life-course (3). This would require measurement strategies to monitor and report on the implementation of a life-course approach within national health policies and programmes. While theories and models related to life-course perspectives have advanced, there remains a gap in literature describing a strategy to measure the operationalization of a life-course approach at a national/state level.

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1.1.4 The objectives of this report

This report uses a scoping review of the literature on measuring the implementation of a life-course approach in health policy-making. A narrative synthesis of the available evidence describes relevant measurement strategies that can be used by both WHO and Member States to measure the degree of implementation of a life-course approach. Relevant details about strategies to measure implementation of a life-course approach, as well as barriers and facilitators to measurement, are discussed to support the creation of an actionable measurement framework to answer the synthesis question: "What quantitative and qualitative methods have been developed for measuring the implementation of a life-course approach in public health policies at the national level in the WHO European Region?"

1.2 Methodology

A scoping review of peer-reviewed papers in English and Russian in academic databases and of grey literature was conducted between 1 February and 30 April 2018. Although the initial focus was on literature from the WHO European Region, the search was expanded to remove geographical limits. Because of the dearth of literature relating to life-course studies that specifically addressed the synthesis question, articles providing examples of implementing a life-course approach in health policy-making were included if they provided information on measurement, including those based on health promotion policy-making. Experts in the field were contacted to suggest further literature, and websites of relevant international and intergovernmental organizations were screened to identify documents that focused on, or included in their objectives, measurement of the implementation of a life-course approach and had a plan for monitoring and evaluating this implementation. Sources were eligible for inclusion if they were published from 1 January 2007 to 30 April 2018.

A total of 5375 articles were identified after removal of duplicates and screened by title and abstract and then by full text. This gave 24 articles for the final review (18,30,34–55). All were in English as the Russian search retrieved no documents. The narrative synthesis was developed, grouped by type of methodological approach and areas of measurement, and then used to inform policy considerations.

Annex 1 gives full details of the search strategy including search terms and inclusion criteria.

2. RESULTS

Notwithstanding an abundance of literature describing models for a life-course approach and its value in health promotion, precise guidelines for its implementation and measurement could not be found and very few studies directly answered the synthesis question (35–38). Of the 24 documents included in this report, some suggested validated measures as indicators for evaluating programmes focusing on a range of issues based on a life-course approach (35–39,49), and others indirectly indicated implementation of a life-course approach (18,30,34,40–48,50–55). Most of the documents identified either focused on specific stages of the life-course (e.g. pregnancy, childhood or ageing) and described the best available evidence for indicators and variables for these different life stages or were based on broad areas such as socioeconomic status and child development. The identified research mainly focused on maternal and child health (MCH) programmes, with a dearth of literature on the preconception period, adolescence (defined by WHO as age 10–19 years) and young adulthood. There was also little research examining the long-term consequences of parental health, particularly linkages between maternal nutrition, body weight and mental health and the neurocognitive and behavioural development, educational attainment, health and lifetime productivity of the next generation.

The results are structured in three groups: conceptual frameworks; quantitative methods, including evaluation frameworks and indicator sets; and qualitative methods. The majority of studies were based on research in the United States of America (30,35,36,39–44), followed by those based on policies and programme implementations in the United Kingdom (18,45), Australia (46) and international organizations such as WHO and the International Federation of Gynaecology and Obstetrics (34,37,38,47–53).

2.1 Measurement of the implementation of a life-course approach

2.1.1 Conceptual frameworks

Three of the identified publications provided conceptual frameworks relevant for planning the measurement of a life-course approach (30,34,48). A conceptual framework can help to unpack complex and multifaceted constructs into concepts, elements and domains, thus facilitating the identification and allocation of measurements and relevant tools.

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The first framework (48) is based on the growing evidence supporting a life-course model of ageing (23), and for early life as a period of opportunity to prevent accelerated ageing (17,19). The model considered the sum of an individual's physical and mental capacities (intrinsic capacity) and defined a set of domains based on data from published longitudinal surveys on ageing. To assist in translating theoretical models into practice, the International Classification of Functioning, Disability and Health was used as an initial framework (56). The Classification uses a disability-based approach, which is the opposite of the healthy ageing model as the latter moves beyond a traditional disease/disability-focused model to an approach including positive attributes that contribute to an individual's reserve function (48). To explore the application of the model in clinical settings, data from longitudinal studies on ageing have been used to identify domains and potential measures within each domain (57). The five domains identified based on a literature review to guide the operationalization and measurement of intrinsic capacity were locomotion, vitality, cognition, psychology and sensory (48). Based on this model, WHO is currently working to identify a concise set of indicators of healthy ageing and to outline a process to disseminate, test and refine these indicators for different settings (58).

The second framework (the life-course health development model) considered the development of individual and population health and the interactions between biological and environmental factors over the life-course, thus providing a construct for interpreting how experiences in the early years of life influence later health conditions and functional status (30). The model called for the vertical, horizontal and longitudinal integration of services. Vertical integration would include linking primary, secondary and tertiary care within different health disciplines, and horizontal integration would merge health services with other sectors such as social and civic sectors. Longitudinal integration of services would require linkage across different life stages (e.g. pre- to postnatal care, childhood through adolescence) and across generations (parents–child). The model has informed programmes and studies related to measurement of children's health and maternal health and those addressing health inequalities (30,59,60). The model suggests that tracking children and adults longitudinally and using time series data for individuals and populations would provide evidence to guide policies and interventions. Markers in several domains would allow temporally linked health trajectories to be identified and understood. Examples of this approach include following cognitive outcomes and trajectories for a community to identify any linkage between early childhood literacy and decline in cognitive abilities in later life, and using childhood health parameters linked to specific disorders to predict future health needs in that population (e.g. onset and

severity of asthma in children, their access to care and its quality, and community success in eliminating pests and allergens; and long-term respiratory function in the elderly and the need for respiratory care).

The third conceptual life-course framework incorporated crucial concepts such as functional ability, well-being, resilience, risk, life stages, and the realization of rights and determinants of health (Fig. 1) (34). Unambiguous and universal definitions of these components were considered essential to operationalize the framework. Aspects of the life-course model align effectively with the SDGs, for example health and well-being (SDGs 2–5) and realization of rights (SDGs 5, 10, 16 and 17) (2). Key issues were identified in measurement, monitoring and research related to a life-course approach, such the need for international standards incorporating a core set of indicators applicable to all life stages, information on age ranges for specific life stages and critical periods for effective targeting of interventions. The report recommended shifting towards modifiable determinants of health that influence health throughout life and the identification of interventions that could produce the greatest gains at different life stages. Ongoing activities to support measurement of the implementation of a life-course approach include data collections, such as birth cohorts; longitudinal and intervention studies, such as WHO's Study on Global Ageing and Adult Health (61); improved capacity to evaluate programmes; and creation of information systems in countries to use existing data on health and social and environmental determinants for policies and programmes.

2.1.2 Quantitative measurement frameworks

Research overwhelmingly supports investment and evidence-informed policy in early childhood interventions. Supportive data are mainly drawn from targeted interventions. The development of longitudinal studies and birth cohorts has supported such policy debate and formation. Realizing that provision of prenatal care alone was insufficient to improve birth outcomes in low-income communities, it was proposed that a life-course perspective should be integrated into a local MCH programme in Contra Costa County, California (43). Initiatives were developed to improve health using a longitudinal, integrated and ecological approach through MCH programmes, for example Building Economic Security Today and the 15-year programme Life Course Initiative, intended to reduce inequalities in birth outcomes. The primary aim of the projects was to improve birth outcomes such as birthweight and reduce preterm births in the community. The 12-point plan to improve birth outcomes using a life-course approach included objectives such as improving preconception and interconception care, enhancing systems coordination and integrating family support services. The study examined independent associations

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between programme efforts and MCH outcomes using changes in staff knowledge as examples of indicators for programme implementation and assessed how staff were using the language of a life-course perspective in routine work. However, the study faced challenges with identifying methodologies to determine the impact of the initiatives and changes over time.

With the aim of monitoring life-course initiatives in pregnancy to prevent NCD development and prevent the transmission of risk of NCDs, the International Federation of Gynaecologists and Obstetricians recommends monitoring of hyperglycaemia in pregnancy and the birthweight of the baby as key components for measuring the outcomes of life-course MCH programmes (49).

A systematic review on life-course cardiovascular research suggested that longitudinal studies can be used effectively to develop post hoc measures from existing data for childhood adversity (39). Most studies included in this review were based on the accumulation-of-risk model. Studies examined different cardiovascular outcomes using cardiometabolic biomarkers, inflammatory biomarkers, anthropometric outcomes (e.g. body mass index) and blood pressure. Retrospective accounts of adversity using standardized questionnaires also allowed for comparability across studies and facilitated the exploration of interventions in a population-based setting. However, it was concluded that this approach lacked a time-based component and could introduce biases related to recall and social desirability (39). The need to study positive factors that might enhance resilience and promote cardiovascular health was also emphasized (39).

The United Kingdom's strategy document to reduce obesity committed to using a life-course approach through whole-population initiatives (18,62). The Healthy Lives, Healthy People strategy suggested that focusing on children alone will not adequately address the issue of obesity in that age group, and that interventions based on behavioural change could prevent obesity in adults, thus creating a positive intergenerational effect. The strategy recommended harnessing existing routine surveys such as the National Child Measurement Programme in the United Kingdom for monitoring effectiveness.

2.1.3 Indicator sets

Documents using indicators were identified (35,36,46,47,51,63–65), including several indicator sets that target age groups or diseases and that could be utilized to monitor life-course parameters. Four types of indicator frameworks or groups of measures specified component indicator sets that can be measured quantitatively, usually at a population level; all focused on a particular life stage as the target group but

all aimed to achieve health benefits in subsequent stages of life: the Life Course Metrics Project (35,36), a life-course approach to measuring socioeconomic position in population health surveillance systems (46), early childhood development (ECD) (47,64,65) and WHO's NCD global monitoring framework (51).

The first indicator set was from the United States Association of Maternal and Child Health Programs, which began in 2012 to develop indicators to monitor and evaluate the application of a life-course approach in public health at the state or community level (35,36). The Life Course Metrics Project considered perinatal/infancy, early childhood, school age, adolescent, young adult and adult life stages. Following several consultation meetings, team of experts from seven states generated a list of 59 MCH life-course indicators (35,36). The resulting indicator set had measures overlapping with routine MCH measures in the selected regions, illustrating that existing platforms could be effectively utilized for implementing and measuring the life-course model. Indicators on resilience and protective factors were limited because of lack of data. The list of indicators provided is of use to MCH services and policy-makers, but using the same set of indicators in multiple countries could be challenging. For example, the indicator of low birthweight was further divided into preterm birth and small for gestational age. Most existing surveys and reports for MCH report on low birthweight but not necessarily on small for gestational age. Details on the Life Course Metrics Project are presented in Case study 1.

Case study 1. The Life Course Metrics Project in the United States

Core features

Indicators were chosen after assessment of five core features related to a life-course approach:

- **equity**: reflects, and has implications for, measures such as social, psychosocial and environmental conditions (including poverty, disparities and racism);
- **resource alignment**: reflective of programmes, services and policies that expand beyond the traditional MCH focus;
- **impact**: public health impact of a positive change (increase or decrease depending on the indicator) in the indicator resulting from the programme or policy interventions;
- **intergenerational wellness**: time and trajectory component of the life-course theory with an emphasis on indicators that address critical and transitional periods throughout life; and
- **life-course evidence**: current scientific understanding of life-course health.

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Case study 1. (contd)

Core data requirements

Features for data were:

- **availability**: in each of the public health agencies in the 50 states and the District of Columbia;
- **simplicity**: simple to calculate; easy to explain the meaning and use of indicator to professionals and the public; and
- **quality**: quality data available for measuring the indicator.

Key features of indicator selection

Multiple national-level data systems were used during the eight-step indicator selection process, including a call for proposals, screening, vote on proposals release for public comments, refinement and finally dissemination and development of a toolkit. Key features were:

- lifespan stages considered, include perinatal and infancy, early childhood, school age, adolescents, young adults and adults;
- indicators included those not commonly used for MCH programmes, such as fluoridation, concentrated disadvantage and homelessness;
- many indicators relied on cross-sectional data;
- indicators covered a range of issues such as contraception, immunization, adverse childhood experiences;
- no report of rigorous methods used to test and check the validity and reliability of the indicators;
- states selected preventable measures that contributed to mortality rather than mortality indicators;
- indicators also aligned with the United States' Healthy People 2020 focus areas and targets; and
- gaps in the indicator set were addressed, such as issues related to lack of available data for resilience and protective risk factors, leading to limited indicators for these concepts.

Indicators were excluded during the selection process predominantly because of lack of data at the state level and lack of the desired quality for indicator sensitivity, specificity, positive predictive value, reliability and consistency across jurisdictions. Indicators that were too complex to calculate and/or explain to professionals and the public were also excluded. The life-course criteria that were particularly challenging to apply were those of equity and impact

Case study 1. (contd)

across the lifespan. To overcome these issues, a broader definition of equity was adopted (any disparity in a risk factor or health outcome) and indicators were examined to focus on the most critical/sensitive life stages.

A subset of the life-course indicators has been used by states to create their own tools (e.g. Iowa's Life Course Indicators Adolescent Health Product, an interactive tool designed for school nurses).

Indicator categories

The original proposed set of 413 indicators was reduced to a final recommendation of 59 MCH life-course indicators. These fell into 12 broad categories: childhood experiences, community health policy, community well-being, discrimination and segregation, early-life services, economic experiences, family well-being, health-care access and quality, mental health, organizational measurement capacity, reproductive life experiences, and social capital.

The indicator list is currently being adopted by states such as Florida, Iowa, Louisiana, Massachusetts and Michigan for tracking health across the life-course to inform policy-makers, support strategic decision-making, support collaboration and identify gaps in programmes and opportunities for improvement. The full indicator list is available on the website (35).

Source: The Life Course Metrics Project (35); Callahan et al., 2015 (36).

The second set of quantitative indicators was used to measure the effectiveness of policies and programmes using a life-course approach (46). Indicators were grouped in broad categories of education level, income, occupation, living conditions, family structure and residential mobility, with the aim of identifying indicators of early-life socioeconomic position that could be used in population health surveillance systems.

The third type of indicators included in this report were devised for population-level assessments of ECD and for evaluating ECD programmes (47,64,65). Improving health and development in early childhood is seen as crucial for improving health through the life-course and is, consequently, considered a core component for implementing a life-course approach (66). Economic and health-related proxies (e.g. poverty, mortality, stunting and low birthweight) have been used in global health contexts to estimate the well-being of children (67) but are minimally

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responsive to programmatic interventions and are context specific (68). It has also been suggested that population-level measurements of ECD should be easy to use, focus on multiple domains, have outcomes aligned with global initiatives and involve tools that are evidence based, reliable and validated (68). The World Bank has developed the ECD toolkit, which can be used for population monitoring, programme evaluation or exploratory research (64). The Early Development Instrument (65) was designed in Canada specifically for population-level monitoring and captures information about children's behaviours and skills in a social setting. It is designed to be completed by teachers and has minimal training requirements (a parent version is also available). The rationale is that social and emotional domains strongly predicted children's emotional well-being and peer relationships at age 10 years (69). The predictive validity and internal consistency of the Early Development Instrument has been tested in Canada and Australia (70) and adapted for use in more than 20 countries (including Estonia, Ireland, Kosovo (in accordance with Security Council resolution 1244 (1999)), Scotland (United Kingdom), Spain and Sweden). A unique feature of using data from the Early Development Instrument is its utility in long-term evaluation of programmes or reforms in preschool/kindergarten provision.

Finally, the WHO's NCD monitoring framework is rooted in a life-course approach (51). A total of 25 indicators (and nine targets) are provided in the framework, which has been used by Member States for reporting health status and risk (63). The framework targets issues such as cardiovascular diseases, diabetes, cancer and chronic respiratory disease. Risk factors such as obesity, alcohol intake and diet (e.g. high sodium intake) influence blood pressure levels and the risk of cardiovascular diseases and cancer in adulthood (71). While the NCD monitoring framework refers to using a life-course approach, the evidence is not clear as to how the indicators identified reflect a time-based component/multisectoral approach in their measurements.

2.1.4 Composite scores

Four documents developed indicator sets with multiple variables to form composite scores (41,44,50,53).

In the first indicator group, validated measures were generated that could either be used independently or be combined into a single index, the Childhood Socioeconomic Scale, for operationalization and measurement across studies (44). The validated childhood measures comprised social capital (two factors: maternal investment and family structure), financial capital (two factors: average financial resources and

financial stability) and human capital (mother's and father's years of education). The Health and Retirement Study, which is based on a life-course approach, was used to develop and validate a theoretical index for the Childhood Socioeconomic Scale, which demonstrated internal consistency, reliability, construct validity and predictive validity ranging from acceptable to good (as defined by assessment criteria in the original study). The study stressed the need for well-defined exposure variables for policy interventions to decrease the impact of childhood socioeconomic disadvantage on later health outcomes.

The second indicator set using composite scores was the Active Ageing Index, a toolkit for comprehensive examination of the activity and independence of people aged 55 years and older (50). Composite measures were created using 22 individual indicators grouped into four domains (contributions through paid activities; contributions through unpaid productive activities; independent, healthy and secure living; and capability to age actively). The Active Ageing Index score for individual countries shows the extent to which they mobilize the potential of their older populations, and the extent to which older people are enabled and encouraged to participate in the economy and society and to live independently. Findings using the Index ranked the 28 Member States of the European Union (EU), with the highest score in Sweden (44.9) followed by Denmark and Netherlands, and the lowest in Greece (27.6). All were below the ideal score of 57.5, which was established and defined using the maximum values observed during the period considered. Challenges highlighted in the report that made data comparison difficult included the lack of age disaggregation in surveys and different definitions for age categories. Both the Active Ageing Index and the WHO's healthy ageing model take into account individual and environmental factors influencing decline in function, and the extent to which older people's potential is used and they are enabled to be independent and encouraged to participate in the economy.

The third score applied commonly used MCH databases to inform life-course MCH research (41). The study generated a neighbourhood deprivation index at the time of each birth (based on a cohort study in Georgia, the United States) and from these further calculated a cumulative neighbourhood deprivation index. It was concluded that education, income and occupational indicators of early-life socioeconomic status directly reflect the resource- and status-based constructs of socioeconomic status and should be prioritized within monitoring and surveillance systems. Proxy indicators of socioeconomic status related to living conditions, family structure and residential mobility could be included if resources permit. It was also suggested that the creation of trajectories from geographically coded longitudinally linked maternal vital records could be used to assess MCH research impact (41). Linkage

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could be undertaken at the level of state public health departments to provide a descriptive and analytical understanding of cumulative experiences and pregnancy outcomes in a population.

For monitoring and reporting on the Madrid Plan of Action on Ageing, indicators were provided for three priority categories: older people and development, advancing health and well-being into old age, and ensuring enabling and supportive environments (53). Monitoring the provision of universal health coverage and equal access to health-care services was also suggested (53).

2.1.5 Qualitative and mixed methods measurement strategies

Quantitative measurements via surveys and other tools can potentially overlook or poorly interpret the context-specific, individual, cultural, sociopolitical, economic and environmental factors that influence health and well-being throughout life. Qualitative methods have been recommended to help to overcome these issues but as yet the potential of these methods has not been adequately harnessed (42). An application of qualitative life-course research in development studies compared exploratory and diagnostic qualitative investigation methods using two case studies: well-being and lifetime relationships in older people in Buenos Aires, Brazil, and economic empowerment in young adults in Zambia (42). It was concluded that exploratory methods were more interpretive but the analysis may be less representative. Diagnostic methods were more structured. Methods used were narratives elicited using a free-flowing format (exploratory) or semi-structured interviews with field researchers (diagnostic). Exploring the context of life-course interventions helped to reveal the wider social and institutional factors and their roles in human lives. For example, in the study of older people, the results suggested that living in socially excluded neighbourhoods contributed to problematic relationships and that less support from children reduced an older person's opportunity to live in a more enabling environment, thereby affecting geographical mobility.

Three of the documents included in this review reported using qualitative methods as part of measurement strategies to evaluate the implementation of a life-course approach (37,38,40). The Healthy Start programme in the United States aimed to reduce disparities in maternal and infant health status in high-risk communities by improving prenatal care to achieve optimum health over the life-course (40). The outcome evaluation included measures such as birthweight (comparisons were made between ethnic groups and between groups with different socioeconomic status), elimination of smoking, insurance coverage, medical homes and check-ups,

unmet needs for health care and breastfeeding rates. A qualitative component and process evaluation used sampling of successful implementation sites, not effective outcomes sites. The study suggested that implementation and programmatic component assessments should be considered for more recent and short-term interventions, and outcome-oriented evaluations for long-term studies.

Iceland used a mixed methods approach (interviews, focus groups, surveys and content analysis) for its Welfare Watch programme (38). Data were collected from various sources (working groups, agencies and civil society, government ministries and the public) and experts were used to analyses the measurements. The Welfare Watch programme was devised to support at-risk groups, such as families with young children, unemployed people and youth (aged 15–25 years), during the financial crisis (38). Iceland used a logic model to structure monitoring and evaluation; defined their short-term, intermediate and long-term outcomes; and used social indicators (for measuring equity-related outcomes). Equity-relevant indicators included social determinants of health and health across social groups at specific life stages or in transition periods. Barriers and facilitators for implementation and uptake of the programme components were identified. Emphasis was given to social indicators as a tool for monitoring conditions and well-being for overall implementation and for specific groups, and for informing future action. Data about the position of children in Icelandic society and the effect of the economic situation on them was gathered to formulate policy for protecting children (38).

In Malta, a life-course approach guided the development and implementation of a multifactor initiative, Healthy Weight for Life, to tackle overweight and obesity across the life-course (2012–2020) (37,38). Mixed methodology was used for monitoring and measurement: qualitative approaches (focus groups for the Schools on the Move programme) and quantitative data (e.g. epidemiological data on obesity) for the evaluation of the overall framework (see Case study 2 below).

Mixed methods have also been used by countries in the WHO European Region to report on the implementation of a life-course approach. In a 2017 report, eight countries from the WHO European Region (37) shared their experiences of implementing life-course interventions. The report noted a number of challenges to using a life-course approach: the complexity of monitoring and evaluation, the lack of suitable data or standardized methods, and time and resources. These Member States' interventions are discussed in more detail in section 2.2.

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2.2 Measurement of implementation of life-course interventions in practice

Within the WHO European Region, Member States have used indicators and measures for monitoring efforts to target specific life-course health issues, but they may not refer to these targets as life-course targets. Eight countries from the WHO European Region shared their experiences of implementing life-course interventions in 2017 (37), focusing on issues such as nutrition throughout the life-course, physical activity, overweight/obesity prevention, improving ECD, vaccines, supporting parenthood, increasing adolescent health knowledge, adverse childhood experiences and long-term integrated health care (Table 1). Not all of these have measurement methodology in place but all are intending to do so. Monitoring and evaluation of programmes was considered essential and it was advised that indicators for life-course actions should be incorporated into population-based data collection (38). Key features that the report identified to support the delivery of programmes and assessment of effects included diversity of participating sectors, political commitment, existence of legislation, using existing working groups, availability of evidence-based literature, data from national surveys, multidisciplinary consultations and public campaigns.

A review to appraise the performance of the Finnish health promotion system (52) suggested that a life-course approach and health in all policies approach are key components of public health programmes. Targets were essentially for different life stages, for example children (improving health and welfare), adolescents (reducing smoking and limiting the use of drugs and alcohol), young men (reducing mortality from violence and accidents), working adults (increasing retirement age through improved functional capacity) and older adults (maintaining upward trends in functional abilities of people aged 75 years and older). The report recommended health impact analyses for these interventions and that the vast amount of information on the health status of populations produced by central authorities, universities and other agencies should be used to its full potential for such analyses.

The National Health Systems Strategy 2014–2020 in Malta aligns with WHO and EU strategies, with an overarching framework incorporating a life-course approach and health in all policies although it does not directly give a monitoring and evaluation plan for implementation of a life-course approach (72). It does refer to several indicators that have been recommended in the literature for surveillance of risk factors and determinants of health across the life-course, and for which monitoring has been recommended as outcomes for life-course

strategies (e.g. tracking childhood obesity and overweight by body mass index, dietary habits in children and adults). The objectives of the Strategy are described using indicators reflecting demographics, lifestyle indicators and indicators for incidence of disease. Several of the indicators used for reporting on these health determinants are recommended measures for a life-course approach, such as blood pressure monitoring for early detection and treatment (73). Case study 2 focuses on the Healthy Weight for Life strategy in Malta. In the Andorra Statement (2015) (74), eight Member States of the WHO Small Countries Initiative committed to serving as pioneers of innovative approaches and role models of best practice in the translation of life-course principles into practice. This included sharing experiences in implementing a life-course approach.

Table 1. Summary of activities and indicators used to report on a life-course approach by the eight small countries in the WHO European Region

Country	Life-course action/ implementation of a life-course approach	Measures
Andorra: national strategy for health, nutrition and sport	Health promotion policy development aimed at disseminating information and promoting healthy eating habits and regular physical activity	A new nutrition survey is planned to inform decisions about the best way to continue promoting healthy eating habits and physical activity across all population groups
Cyprus: strategy to tackle overweight and obesity	A community-based programme as an overall umbrella initiative to promote nutrition throughout the life-course, with multiple programmes targeting different life stages (dietary advice for pregnant women, home visits for screening newborn health, legislation for school lunches, nutrition promotion for men in the army, awareness campaigns for adults, preconception advice on parenting and nutrition for future parents, dietary advice for nursing homes)	Evaluated by epidemiological studies and collecting somatometric measures as relevant for each programme (e.g. weight monitoring for pregnant women, weight and home visits for newborns)

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Table 1. (contd)

Country	Life-course action/ implementation of a life-course approach	Measures
Iceland: Welfare Watch programme	To support at-risk groups during financial crisis	Surveys, interviews, focus groups and content analysis among members of working groups; data from working groups, agencies and civil society, government ministries and the public; experts used to analyse the measurements
Luxembourg: early detection of risk factors that may have a long-term effect on cognitive development and socialization	Screening children 0–4 years of age, with follow-up to 18 years planned	Multiple screening programmes implemented for detection of hearing and language difficulties, vision, vaccine administration, psychosocial support for children and families and detection of rare genetic diseases (evaluation in progress)
Malta: Healthy Weight for Life	Initiatives designed to address barriers to and enablers of a healthy weight at each life stage (see Case study 2)	Separate evaluations are planned for each initiative, using pre- and post-programme questionnaires, along with process and outcome indicators (see Case study 2)
Monaco: initiative for care of the elderly population	Goals are to provide home-based support to the elderly for as long as possible; facilitate the life of the supporting relatives; take care of the elderly in case of loss of autonomy; maintain a high level of care for the elderly	Evaluation carried out annually based on data collected from both the medical and nonmedical structures plus admission rates

Table 1. (contd)

Country	Life-course action/ implementation of a life-course approach	Measures
Montenegro: addressing adverse childhood experiences	Survey undertaken to explore the depth of the issue (with WHO); a strategic response will be based on the results	Evaluation to be conducted
San Marino: tackling childhood obesity through intersectoral action	Prenatal courses and breastfeeding promotion; postpartum support; nutrition in schools	Monitoring by rates of exclusive breastfeeding, school-based systematic surveys (to monitor prevalence of overweight and obesity and food consumption), WHO surveillance systems for overweight, obesity and eating disorders

Source: WHO Regional Office for Europe, 2017 (37).

Case study 2. Healthy Weight for Life strategy in Malta

In Malta, a life-course approach guided the development and implementation of a multifactor initiative to tackle overweight and obesity across the life-course (for 2012–2020) (37,38). Healthy Weight for Life was structured around the continuum of the life-course, with initiatives designed to address barriers to and enablers of a healthy weight at each life stage or in each transition period and to be delivered in multiple settings such as preschools, schools, workplaces, communities and care homes.

The life-course approach in the programme

Programmes targeted parents and children together to address the intergenerational perspective of a life-course approach. Initiatives focusing on nutrition and physical activity were delivered in the prenatal period and childhood to promote the best possible start in life, and also in transitional periods such as adolescence and pregnancy. Healthy Weight for Life has also resulted in numerous programme initiatives, many targeting specific stages in the life-course and delivered in settings relevant to these

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Case study 2. (contd)

periods (e.g. the Lunchbox programme in schools, Kinder educational programme for preschool children).

Healthy Weight for Life also operationalized a life-course approach by adopting an intersectoral approach across multiple disciplines such as policy, education and individual-level behaviour change.

Domains of actions

Three domains were devised:

- **healthy eating**
  - develop policies across government to promote healthy diets;
  - promote breastfeeding; and
  - support schools and families in providing healthy meals and snacks for children;
- **physical activity**
  - develop policies across government to promote physical activity;
  - ensure three hours of physical activity a week for schoolchildren; and
  - support local councils in creating environments that promote physical activity;
- **health services**
  - increase and improve adult weight-management and physical activity classes;
  - increase and improve parent craft and breastfeeding classes; and
  - establish multidisciplinary clinics for the management of excess weight in adults and children.

Key elements measured

The elements measured were:

- process indicators for activities and outputs in implementation;
- changes in the environment, knowledge or behaviour as short-term and intermediate outcomes; and
- changes in health or health equity as long-term outcomes.

Methods

- The final evaluation is planned for 2020. Process evaluation of the project was carried out using measurements of school uptake and attendance and questionnaires.

Case study 2. (contd)

- Programme implementation was conducted using focus groups, toolkits and questionnaires (using a before–after design in participating schools).
- Health equity-related outcomes are being considered.
- Monitoring and evaluation is also being conducted through disaggregation of intermediate and long-term health outcomes across social groups.
- Assessment of effectiveness (e.g. increasing rates of physical activity) will occur through evaluation studies.

The report also suggested that evaluation will be considered throughout the process and sharing of experiences between countries and disseminating tools will support efforts further.

Facilitators and barriers

Facilitators for implementing a life-course approach include:

- sustained involvement of diverse stakeholders in planning and implementation;
- intersectoral approach involving central government, including ministries of education, employment and finance; sports sector; media and nongovernmental actors; local councils and community groups; and the private sector (e.g. restaurants);
- political commitment, supportive legislation and policies; and
- inclusion of people participating in the initiative through opportunities to present their perspectives (e.g. school authorities, teachers, parents, children).

Facilitators for monitoring and measurement include:

- use of mixed methodologies, including qualitative approaches (focus groups for the Schools on the Move programme) and quantitative data (e.g. epidemiological data on obesity) for the evaluation of the overall framework);
- indicators and targets based on existing surveys, improved feasibility and efficacy, and efforts to maximize overlap with the country's NCD strategy;
- effective leadership, strong communication and the establishment of working groups; and
- public consultation and engagement.

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Case study 2. (contd)

Barriers include:

- influence of external factors on outcomes measured for a complex issue such as obesity;
- difficulty in conducting process evaluations for a large multicomponent strategy; and
- requirement for additional resources to expand actions.

Sources: WHO Regional Office for Europe, 2017 **(37)**, 2018 **(38)**.

3. DISCUSSION

3.1 Strengths and limitations of the review

This report is the first to present an overview of how countries are measuring the implementation of a life-course approach globally. In addition, it also provides a useful overview on how implementation has been conducted in multiple settings, and which life stages need further attention. A scoping review was considered to be the most suitable approach as the aim was to investigate methods in current practice. The search targeted studies that refer to using a life-course approach/theory as a framework. There is potential bias towards studies published in English as the search was mainly conducted in English; however, an effort was made to capture literature in Russian, though to no avail. The studies found came mainly from high-income countries, which is consistent with a review on the operationalization of a life-course approach (33).

Measurement of implementation of a life-course approach was not always explicit in the literature and so studies might have been excluded if they did not use terminology that indicates a life-course approach. To capture such studies in a future analysis would require a broader scoping review using search terms related to life-course epidemiology (e.g. related terms such as life cycle or health promotion for particular critical periods). Even so, semantic issues arose in the search because life-course terminologies are used loosely in the literature, leading to several irrelevant studies being retrieved by the title and abstract search. Although the review did identify the use of indicators, including several indicator sets that targeted age groups or diseases and that could be utilized to monitor life-course parameters, no domains or indicators were identified that explicitly measured the implementation of a life-course approach in health policy-making. The indicator lists described in the Results, therefore, are not an exhaustive list of available sets but all allude to or reference a life-course approach.

With these caveats, this report provides a useful overview of how Member States and other countries are measuring the implementation of a life-course approach. Overall, the search results suggest that most countries in the WHO European Region have produced documents stating a commitment to using a life-course framework but no documents specifically outlined direct measurements of implementation. Rather, they used evaluation of the effectiveness of the implementation as a proxy for the implementation of a life-course approach itself.

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Areas that need more attention, and those resources that can assist reporting on life-course implementation, are discussed below.

3.2 Implementing a life-course approach to health: urgency and challenges

Both operationalizing a life-course approach and then measuring that operationalization within actual programmes and policies are complex challenges. Issues affecting implementation include factors affecting the determinants of health across the life-course, such as socioeconomic inequalities and intergenerational genetic/epigenetic determinants; fragmented health-care systems; and the need for resources for long-term follow-up (75). Because of the complexity of addressing wider socioeconomic inequalities, and their multisectoral aspects, this aspect is often overlooked (76). Investments are best made with long-term goals in mind and recognizing that there may not be immediate tangible results.

Studies that follow participants from preconception through pregnancy, infancy, childhood, adolescence, adulthood and ageing are essential but present methodological challenges in terms of techniques and statistical software that can accommodate such contextual data (77). Yet, one model will not answer all implementation needs and models need to be modified based on the target group, context and health issue. Involving key stakeholders from the inception of implementation, including members of civil society, helps in incorporating contextual factors that influence the uptake and delivery of initiatives. An example of the insights possible, in terms of when and where to intervene for maximum benefit, can be drawn from New Zealand's social investment model to improve government's knowledge of service delivery (78). This model uses data-driven analysis for identifying target groups in the population (using administrative data), monitoring the impact and effectiveness of social services and determining whether the services have been delivered to those who need them most. An analysis of an MCH programme in the United States concluded that outcomes were improved by collaborating with non-health sector partners (economic, housing, environment), addressing the social determinants of health and focusing beyond the perinatal period (43).

There have also been initiatives that use a life-course approach and whole-population approaches to prevent the development of obesity. The Report of the Commission

on Ending Childhood Obesity highlighted in 2017 the importance of using a life-course approach to prevent childhood obesity and NCD risk by monitoring preconception and antenatal parameters such as gestational hyperglycaemia and weight gain during pregnancy (79). The Report also recommended monitoring the implementation of legislation or regulations on marketing complementary foods for infants and young children and unhealthy foods.

The studies included in this report provide valuable insight into indirect methods for measuring implementation of a life-course approach. As a first step, a policy agenda is needed that addresses the prevention of social and individual risk factors for disease and impaired function at critical points in the life-course through the development of a seamless health and social and care system across the life-course that focuses on achieving optimum health. Collaboration between various sectors is also essential as working in so-called silos for short-term health problem solutions and improvement in indicators may hinder achieving health goals and the successful use of a life-course framework. The intersectoral approach adopted by small countries such as Malta and Iceland illustrates the efficacy of linking multiple health strategies across different life stages to address the alarming new trends in chronic diseases such as obesity and cardiovascular diseases (37). A further priority is to ensure continuity of health and social care, including monitoring of interventions or new initiatives, from birth throughout the lifespan. Multiple reports have emphasized improving nutritional status before pregnancy in order to target the earliest stages of the life-course for short-term benefits and long-lasting effects on risk of obesity and NCDs throughout life and in the next generation (25,80,81).

Maternal nutrition should be part of a life-course approach that considers perinatal health within the context of women's overall health. Use of a life-course approach also includes addressing needs of children, families and other groups in different settings, such as schools and worksites. In addition to actions on prevention, access to early diagnosis, treatment and care for children and adolescents with NCDs is also vital and has a direct impact on the reduction of preventable death and disability (82). Simple, cost-effective public health measures, including provision of education programmes and sustainable newborn screening, can have a major positive impact on health outcomes such as birthweight, with its subsequent effects across the life-course. Four key areas for implementation of a life-course approach have been identified that are in synergy with the SDGs: policy and investment; health service systems; multisectoral and multistakeholder action and measurement; and monitoring and research (34).

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3.3 Measuring the implementation of a life-course approach

Using a systems approach could potentially help in mitigating the complexities related to operationalizing a multidimensional concept such as whole-of-life health care and allows consideration of multiple interacting factors while planning interventions (83). Measuring environmental and external impacts is also essential to remove barriers to achieving optimal health. The literature identified in the report suggests that planning should include strategies to link programmes for women, children and families with other service systems that can address environmental factors such as employment services, housing, family support programmes and so on. This planning will require horizontal linkages to be developed with agencies that go beyond the usual remit of MCH services (28,60).

The studies discussed in the Results and the case studies utilize a life-course approach but predominantly report on the evaluation of effectiveness, with less focus on measuring implementation. This represents a missed opportunity to monitor implementation of a life-course approach during routine surveillance exercises conducted by Member States.

The three groups of measurement (conceptual frameworks, quantitative methods and mixed methods) described from the findings indicate that a combination of methods is best suited to support ongoing efforts to measure and monitor life-course programmes. Studies included in this report recommended the use of existing data collection programmes and retrospective data collection to measure implementation of life-course programmes (34,36,39,48,60). For example, the Health Behaviour in School-aged Children survey (84) is a research collaboration with the WHO Regional Office for Europe and is carried out every four years in 48 countries across Europe and North America. The Global Youth Tobacco Survey monitors tobacco consumption in youth and is also carried out every four years (85). Such surveys provide a platform for monitoring progress and developing appropriate programmes for youth, as reducing the emergence of problems during adolescence can have a substantial effect on the burden of health problems that track into adulthood (see Case study 2 and Table 1). Other platforms that can be harnessed include the WHO Study on Global Ageing and Adult Health (86) and the European Health Examination Survey (87). The former is a longitudinal study collecting data on adults aged 50 years and older, plus a smaller comparison sample of adults aged 18–49 years, from nationally representative samples in China, Ghana, India, Mexico, the Russian Federation and South Africa. The European Health Examination Survey

is a collaboration between organizers of national health examination surveys in EU Member States (88). Because chronological age may not accurately represent biological, social, psychological or functional age, or an individual's experience of ageing (23), clearer information on age ranges for specific life stages and on how to identify critical phases is needed in order to target programmes effectively and develop valid measures.

Studies included in this report suggested the use of longitudinal data as key to measuring life-course trajectories. Many European cohorts exist (89) offering unique features, such as the Southampton Women's Survey (preconception cohort) (90) and others enrolling women during pregnancy or children shortly after birth. Data from cohorts such as the Lothian birth cohort (1921, 1936) in Scotland (United Kingdom) (91), the Dutch Hunger Winter families study (1945–1946) (14) and the Helsinki Birth Cohort (1934–1944) in Finland (92) are now being used to study health in older people and the influence of early-life factors on chronic diseases in adulthood and ageing. Differences in trends in health status seen in different age groups can reflect cohort effects, whereby individuals may start their life-course at higher or lower points (better or poorer, respectively) on the health–disease continuum. Consequently, birth cohorts may go through changes in social and economic policies (e.g. provision of free lunches at school, taxation policies) and medical care, at different times, and this will be reflected in the health behaviours and environmental exposures that a cohort faces in life (93).

The trajectory of decline in function during ageing is connected to health during childhood (19). Studies have recommended adopting strategies such as tracking the health status of children and adults longitudinally and using time series data for individuals and populations to guide policies and interventions (30). As this is challenging to achieve, alternatives include using repeated sets of cross-sectional data, using archival data (8), using cross-sectional data from a single study with a very wide age range and/or generating an artificial birth cohort by combining cross-sectional and/or longitudinal data from multiple cohorts covering different age ranges, usually with some overlap (94). A minimum of two measures is necessary to observe change over time, and a minimum of three measures to allow any description of patterns in trajectories (95). Household panel data available in different countries offer repeated measurements of indicators related to health and social conditions. In some countries, unique identification numbers attributed to each citizen allow linkage of data from a range of sources (census, social surveys and medical records) and provide rich information over the individual lifespan. Existing surveillance systems only measure socioeconomic status at the time

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of the survey, so using a truly life-course approach would capture the dynamic nature of socioeconomic structures and experiences and allow examination of their long-term effects on health during different life stages (41). Indicators of socioeconomic status in early life could be used in routine population health surveillance to monitor trends in the health of populations over time, and to study the long-term effects of policies on changing health. Along with direct indicators of socioeconomic status in early life (e.g. education, income and occupation of parents), proxy indicators reflecting living conditions, family structure and residential mobility can be used to provide insight into the pathways between socioeconomic position and health over the life-course.

The health of individuals and populations has traditionally been measured according to outcomes such as disease, disability, mortality and other health deficits. However, a life-course framework addresses the potential and future health of individuals and populations, and thus the benefits of long-term investment. Core domains need to be identified that can be applied to all life stages and health indicators (based on context). Based on the findings of this scoping review, Annex 2 provides some key points to be considered while developing such a framework. Good-quality data on health, health equity and the determinants of health are available from multiple existing surveys and systems for different life stages. Aligning these monitoring frameworks (e.g. the SDG target indicators) with Member States' efforts to use a life-course approach is essential. Indicators and measurement sets for population-level assessment must be easy to assess using toolkits, while maintaining reliability and validity and also being cross-culturally and cross-linguistically comparable. Research projects often generate evidence across the life-course using longitudinal cohort designs and measurement of a range of variables. This may not be feasible for public health promotion programmes. The monitoring and evaluation of preventive services with a life-course basis will require selected indicators that can be measured through repeated cross-sectional surveys, for example the Health Behaviour in School-aged Children survey. Social, educational and health policies targeting children and young people have health effects that are expressed in the future, and using a life-course approach in surveillance helps to capture these trajectories. Finally, monitoring is essential to ensure accountability and should be conducted simultaneously with plans for implementation.

Life-course research helps to identify when measures should be taken, and interventions implemented, in an individual's lifespan to improve health. The long duration between intervention and outcome still remains one of the major challenges in measuring the effectiveness of programmes. Identifying

indicators and measures for the implementation of a life-course approach requires collaborative efforts from public health entities, data and surveillance programmes, and service providers. Obtaining adequate and appropriate measures is not the only issues for the evaluation of programmes based on a life-course approach, because the analysis of such large and complex datasets will also require innovative methods (7). Monitoring and evaluation of such life-course-based preventive services, which are often multidisciplinary, will require quantitative as well as qualitative strategies. Applying life-course concepts to ageing also calls for a different approach from the simpler life-course models described above (94). Along with differences in definitions of healthy ageing, there is also increasing interest in measuring biological over chronological age (23), for example the development of tools such as the epigenetic clock, which measures biological rather than chronological age across the life-course (96). This tool is based on DNA methylation age acceleration, which is associated with physical and cognitive fitness in later life. The added value of such markers in later life is in predicting future outcomes such as mortality, morbidity and function (94).

The need for disaggregated population information with respect to age, sex, educational attainment, socioeconomic status and rural/urban status to provide better insights into experiences of ageing has been highlighted by the composite scoring system of the Active Ageing Index (50,97). Other issues noted in surveys included poor-quality data on aspects of welfare such as mental health and children's well-being, and lack of coverage of subgroups of the populations in surveys measuring indicators (38). Generating a unified set of indicators from the existing indicators and frameworks used by policy-makers is challenging because of the heterogeneity in life-course stages within and between countries.

3.4 Policy considerations

While not necessarily identifying every existing framework for indicators, this report provides evidence-informed best practice examples. Moving towards a life-course paradigm is a lengthy process and requires considerable groundwork for initiating long-lasting change. Targeting key stages of the life-course such as preconception, pregnancy and early childhood has been shown to provide long-term benefits. While strategies for monitoring specific conditions exist, further research is needed to develop a valid, versatile reliable and responsive framework to measure the implementation of a life-course approach for use at a policy level and that can be translated to community-based and clinical programmes. A life-course approach can be executed in parallel with measures to achieve the SDGs. Regular independent

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reviews of strategies and governance are required to improve accountability within life-course approaches, for example in preventing the increasing burden of NCDs. Member States committed through the Minsk Declaration to apply a life-course approach to improve the health status of their populations, but these efforts need to be supplemented by monitoring progress in implementation. Political commitment will be required to capitalize on a life-course approach advanced by public health organizations within each country and to develop a plan for evaluation.

The policy considerations presented here will support current efforts to implement a life-course approach and to develop an actionable plan for measuring and monitoring implementation through public health policies and interventions. In developing measurement strategies, the following policy considerations are proposed:

- develop an implementation measurement framework or a life-course approach that aligns with existing monitoring frameworks (e.g. the SDGs and national NCD strategies) and reflects horizontal linkages (multisectoral across policy sectors and interdisciplinary across research areas) as well as tracking intergenerational trajectories using longitudinal and time series data across different life stages;
- utilize existing commonly used data and data collection methods, as suggested in this report, and explore linking data across existing social, medical, educational and other systems;
- utilize the existing measures identified in this report and refer to them specifically as measures of a life-course approach;
- take into account features such as equity, resource realignment, impact, intergenerational wellness and the current scientific understanding of life-course health when selecting indicators for measuring a life-course approach;
- build on existing qualitative and mixed methods approaches and explore how to measure context-specific behavioural and psychosocial pathways influencing health and well-being across life stages; and
- promote life-course research by supporting health information producers and researchers in developing interdisciplinary longitudinal studies across the lifespan and across generations to determine the full scope of life-course influences, including using a common terminology for life-course concepts and developing a strategy for implementing a life-course approach in population, clinical and policy settings.

4. CONCLUSIONS

Recent advances in life-course approaches to health have revealed the linkages between an individual life, historical time and place and how this can be harnessed to optimize an individual's health. While countries in the WHO European Region have frequently discussed the implementation of a life-course approach in public health policy-making for multiple health conditions, a robust strategy for measuring implementation is lacking.

Overall, there were not many reports that contained efforts to measure implementation of a life-course approach. One solution to this issue is to conduct longitudinal surveys with sufficient statistical power, but this is not an easy task. It is possible to develop a set of indicators by building on existing data sources but this requires prioritization of unambiguous definitions of the core concepts and the constructs that need to be measured. These indicator sets could be adapted based on context-specific needs. WHO is currently examining the concept of intrinsic capacity and linking this with the SDGs, and the WHO Regional Office for Europe is specifically looking at life-course approaches. The methods used to measure and report on initiatives grounded in a life-course framework could utilize strategies described in this report, such as indicator sets or composite scores (designed using existing survey platforms), qualitative methods and quantitative methods. As research in this field continues to mature, it is a good time for those making policies and health programmes to scale up their efforts to implement a life-course approach by integrating services within different health disciplines, across health-care sectors, across different life stages and with other sectors having an impact on health and well-being. There still remains a need to identify the key areas and targets for monitoring a life-course approach to health and to conduct in-depth reviews for each area to identify suitable indicators to reflect the core features of equity, resource realignment, impact, intergenerational wellness and understanding of life-course health. Indicators need to be feasible for measurement, encompass broad sociocultural contexts and be suitable for adjustment for country- or population-specific targets or goals. Existing survey platforms and routinely collected quantitative data could be utilized to report on existing interventions at key stages of the life-course and to support the creation of a monitoring and evaluation framework that reflects positive health and well-being and not merely deficits in health.

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ANNEX 1. SEARCH STRATEGY

Databases and websites

A search for peer-reviewed papers in English and Russian between 1 February and 30 April 2018 was conducted on academic databases (Cumulative Index to Nursing and Allied Health Literature (CINAHL), International Bibliography of the Social Sciences (IBSS), Medline and Web of Science) and for grey literature. As the preliminary scoping search provided few relevant results, an expanded search was conducted on Medline to identify studies relevant to measurement and evaluation that were potentially missed initially (yielding 2253 new titles and abstracts). Google and Google Scholar searches were carried out after the academic websites were screened to avoid saturation of information. Although the focus of the report was on studies based in WHO European Member States, the limited literature available led to extension of the search to worldwide sources.

Websites of governments, international organizations and nongovernmental organization were screened (using Google Translate if needed) to identify documents that focused on, or included in their objectives, the measurement of the implementation of a life-course approach, and provided a plan for monitoring and evaluating this implementation. For selected organizations (see below), websites were searched using the organization's publication database (if any). Advanced search features were used to restrict the number of documents when needed, for example by subject areas.

An external expert was contacted for the search for documents in Russian in the following databases: Bielefeld Academic Search Engine, Cyberleninka. East View, eLibrary, Nauka-rastudent, Scholar.ru database of scientific publications and the scientific archive of the Ministry of Education and Science of the Russian Federation. The term "life-course approach" in its official form proposed by the Health 2020 translation "охват всех этапов жизни" is frequently mentioned in Russian language sources, particularly after the Minsk Declaration in 2015 (1). While a significant number of publications in Russian described the Minsk Conference, the main principles of Health 2020 (2) and the concept of a life-course approach to health and lifestyle devoted to particular social and age groups (e.g. babies, children, economically active population or elderly), few were identified that described the steps and actions required for programme implementation and none that referred to any tools or mechanisms overviewing/measuring the success of Health 2020

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implementation and progress with the introduction of its principles. Consequently, this search did not provide any of the articles for the final review.

Experts in the field were contacted to generate further literature suggestions, illustrative case studies and best practice examples. Additional documents were identified through expert contributors, during March–May 2018.

The period from 1 January 2007 to 30 April 2018 (the term "present" being applied during the database search) was chosen for the literature search because publications prior to 2007 focused mainly on descriptions of theoretical models and cohort studies rather than implications for policy and monitoring/evaluation. The most recent versions of strategy documents and reports were used.

Inclusion and exclusion criteria

Inclusion criteria were:
- measurement or evaluation of the implementation of a life-course approach or related concepts;
- published from 1 January 2007 to 30 April 2018;
- available in English or Russian;
- worldwide settings, and recommendations and strategies published by global health agencies;
- all population groups (all stages of the life-course); and
- all settings and study designs.

Because of the dearth of literature relating to life-course studies that specifically addressed the synthesis question, documents were also considered if they:
- primarily focused on risk factors for particular stages of the life-course but also provided recommendations for indicators; or
- were examples of implementing a life-course approach but also provided information on measurement.

Exclusion criteria were:
- study designs that examined health over the life-course but did not consider measurement strategies or implementation of a life-course approach;
- reports on risk factors and markers of risk for specific conditions;
- reports on specific interventions (e.g. randomized clinical trials or pathophysiology of NCDs);

- document available in languages other than English or Russian; and
- reports on outcomes of birth cohorts and prospective intervention studies based on a life-course approach if they did not provide recommendations for measuring the implementation of a life-course approach or provide monitoring and/or evaluation strategies.

Search terms

Certain keywords such as "interventions" or "health promotion" were excluded because their sensitivity and lack of specificity extend beyond the scope of this scoping review and would cause deviation from the primary synthesis question. To ensure that relevant strategies of implementation related to life-course concepts were captured, searches with life-course and adjacency terms were broad. Results were exported into Endnote software and duplicates were deleted.

CINAHL

("life-course" OR lifecourse N3 (theor* OR perspective* OR stud* OR approach*)) AND (measur* OR evaluat* OR indicator* OR implement* OR policy)

Timespan last 10 years

Limiters published date 20070101–20180431, English language; peer reviewed, exclude Medline records

Results narrowed by subject majors

IBSS

("life course" OR lifecourse NEAR/3 (theory* OR perspective* OR stud* OR approach*)) AND (measur* OR evaluat* OR indicator* OR implement* OR policy)

Timespan after 1 January 2007

Document type (HM) Sociology, Abstract, Article, Articles, Book, Book Chapter, Case Report, Case Reports, Case Study, Case_Study, Commentary, Conference Paper, Conference Proceeding, Conference Proceedings

Medline

((life course or lifecourse) adj3 (approach* or theor* or perspective* or method* or stud*))

Limit 1 to yr="2007-Current"

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Web of Science

("life course" OR lifecourse NEAR/3 (theory* OR perspective* OR Stud* OR approach*)) AND (measure* OR evaluat* OR indicator* OR implement* OR policy)

Timespan 2007–2018

Results refined further based on source types (journal articles, conference proceedings)

Expanded Medline search for related concepts

1. Life course.tw
2. Lifecourse.tw
3. or/1–2
4. measure*.tw
5. evaluat*.tw
6. implement*.tw
7. POLICY/ or PUBLIC POLICY/ or policy.mp. or HEALTH POLICY/ or POLICY-MAKING/
8. indicator*.mp
9. or/4–9
10. 9 and 3
11. Limit 10 to (English language and yr=2007-"Current")

Google and Google Scholar

"life course OR lifecourse" AND (measure OR evaluation OR framework)
"life-course OR lifecourse" AND (implementation)

Grey literature

Mednar: (lifecourse OR life course) AND (measur* OR indicator*)
OpenGrey: lifecourse OR life course

Websites of organizations and health agencies

American Public Health Association, Australian Government Department of Health, Centers for Disease Control and Prevention (United States), Centre for Reviews and Dissemination (University of York, United Kingdom), Danish Health Authority, European Commission, European Community Psychology Association, European Public Health Association, International Federation of Gynaecologists
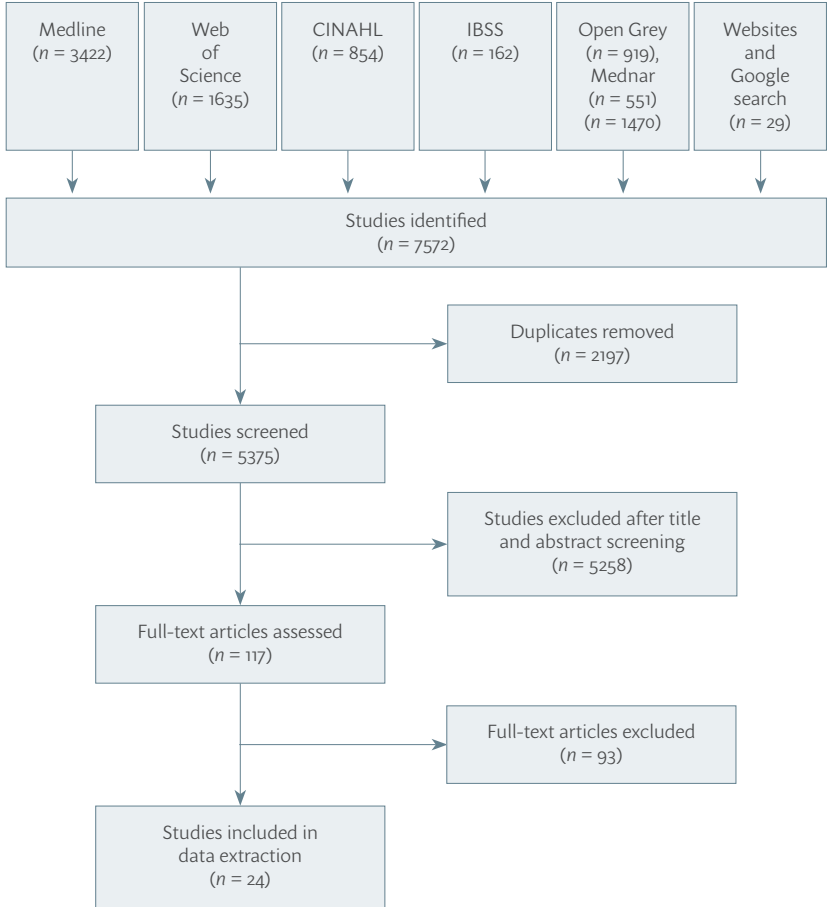
and Obstetricians, Finnish Ministry of Social and Health Affairs, French Ministry of Social and Health Affairs, Health Protection and Promotion (Royal College of Obstetricians and Gynaecologists, United Kingdom), Health and Social Care (Welsh Assembly), Health and Social Wellbeing Improvement (Public Health Agency for Northern Ireland),Institute of Equity, Marmot Review (Fair Society, Healthy Lives; United Kingdom), National Institute for Health and Care Excellence guidelines (United Kingdom), NCD Alliance, NHS Health Scotland, Nordic Co-operation, Organisation for Economic Co-operation and Development, Public Health England, Public Health Ontario, Royal Society for Public Health (United Kingdom), SDG Knowledge Platform, Swedish Public Health Agency (Folkhälsomyndigheten), United Kingdom Department of Health (policy papers for health-related documents), United Kingdom Department for International Development, United Nations Children's Fund, United Nations Educational, Scientific and Cultural Organization, United States Department of Agriculture (Center for Nutrition Policy and Promotion), United States Department of Health, World Bank, WHO Promoting Health through the Life-course, WHO Regional Office for Europe.

Data extraction

The full texts of documents identified based on title and abstract were examined to see whether they fitted the inclusion criteria and their reference lists were hand-searched for publications and citations potentially missed in electronic searches (snowball searching). Data were extracted against fields that related to the objectives of this report. Information on implementation of a life-course approach, if described, was also extracted. Fig. A1.1 shows the selection process for the final 24 documents. To group the results, the ladder of measurement framework (3) was used. This framework was originally developed for a review of asset-based measurement. The framework groups the different methodologies into categories including conceptual frameworks, measurement and evaluation frameworks, indicator sets and scales.

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Fig. A1.1. Selection of studies

Medline
($n = 3422$)

Web of Science
($n = 1635$)

CINAHL
($n = 854$)

IBSS
($n = 162$)

Open Grey
($n = 919$),
Mednar
($n = 551$)
($n = 1470$)

Websites and Google search
($n = 29$)

Studies identified
($n = 7572$)

Duplicates removed
($n = 2197$)

Studies screened
($n = 5375$)

Studies excluded after title and abstract screening
($n = 5258$)

Full-text articles assessed
($n = 117$)

Full-text articles excluded
($n = 93$)

Studies included in data extraction
($n = 24$)

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ANNEX 2. OUTLINE APPROACH FOR OPERATIONALIZING A LIFE-COURSE FRAMEWORK

Fig. A2.1 outlines the concepts to be measured, possible indicators to use and potential methods for implementation (see also the policy considerations in the Discussion).

Fig. A2.1. Operationalization of a life-course framework

Define the concept to be measured

▸ Identify and describe the broader area of measurement (domains)
▸ Build domains on recommended existing life-course models and frameworks and consider internal (biological, genetic) and external (environmetal, sociocultural, health inequalities) determinants of health and well-being
▸ Identify life-course elements in existing interventions and strategies
▸ Identify well-defined exposure variables: conduct validity, sensitivity and reliability analysis, or use tools already tested
▸ Define target groups based on critical periods, ensuring linkages across different life stages

Select indicators

▸ Identify a concise set of effective indicators comparable within and across the population
▸ Explore possibilities to use existing data by reviewing available indicators in toolkits: which of these indicators/domains can be extended to other stages of the life-course?
▸ Review measurement approaches and data inputs required for each indicator
▸ Use clustered indicators to develop composite measures but these may not be applicable across age groups
▸ Core features of indicators: evidence based, with impact, consider modifiable determinants of health, easy to operationalize at multiple settings
▸ Weight of indicators/domains would vary across life stages

Implement an evaluation framework

▸ Operationalize at a national level for translation of models developed into policies/intervention programmes
▸ Test at regional/national level
▸ Incorporate mixed methods (stakeholder and participant interviews) for monitoring
▸ Use existing platforms and surveys for different age groups using a multidisciplinary, multistakeholder approach