

Lifespan Approaches to Women's Health Integrating Biological Transitions, Social Determinants and Precision Care Across the Life Course

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Abstract — A lifespan approach to women's health redefines clinical and public health practice, repositioning care from episodic, reproductive-centred models toward longitudinal, equity-based, prevention-oriented frameworks. Biological transitions including puberty, reproductive maturation, pregnancy, menopause, and ageing combine with cumulative psychosocial, environmental, occupational, and structural exposures to shape long-term health trajectories. This paper synthesises current evidence of women's health from early development through older adulthood, drawing on life-course epidemiology, sex and gender-specific biomedical research, pharmacotherapeutic evidence, and social determinants models. Key domains examined include reproductive health, mental health, bone and cardiometabolic health, chronic disease prevention, nutrition, occupational health, digital transformation, and longevity science. Key findings demonstrate how early-life exposures relate to mid and later-life functioning, how structural inequalities compound health risks over decades, and how well-timed interventions at key developmental stages can maximise lifelong wellbeing. The paper concludes that interdisciplinary integration, precision medicine, digital engagement strategies, and equity-based policy reform are essential for comprehensive women's healthcare optimisation throughout life.

Keywords — Lifespan Women's Health; Life Course Epidemiology; Preventive Healthcare; Reproductive Transitions; Menopause; Healthy Ageing; Social Determinants Of Health; Precision Medicine; Digital Health Integration; Gender Equity; Chronic Disease Prevention; Women's Health Policy.

1. Introduction

The concept of women's health scholarship has evolved from historical examination of women solely through reproductive functionality toward a multidimensional approach combining biological sex differences, gendered experiences, and structural determinants within a life course framework (Rodin and Ickovics, 1990; Wyn and Solis, 2001). The lifespan approach views health as a cumulative lifelong process influenced by biological changes, behavioural tendencies, environmental exposures, and social circumstances experienced from early childhood through old age. Hardy, Kuh, and Mishra (2023) characterise the life course model as a dynamic analytical framework examining interactions between developmental exposures over time to determine disease risk, resilience, and ageing processes.

Lifespan-oriented healthcare has ethical foundations in the principles of distributive justice. Daniels (1992) argues that equitable health systems should provide fair opportunity to health at every phase of life, justifying investment in early prevention, defence of reproductive autonomy, management of midlife transitions, and promotion of healthy ageing. Recent studies emphasise the need for sex and gender-specific approaches (McKinney et al., 2024). Hormonal regulation, pharmacokinetics, immune

activity, and cardiometabolic responses frequently differ between women and men, requiring individualised clinical models. Specific physiological transitions in women—menarche, pregnancy, lactation, perimenopause, and menopause—each carry particular health vulnerabilities and preventive intervention opportunities. A lifespan framework thus synthesises biological transitions, psychosocial development, environmental exposures, and systemic inequalities to maximise women's health outcomes across decades.

2. Conceptual Foundations and Early Life Health Trajectory Formation

The lifespan approach is grounded in life course epidemiology, developmental biology, public health, and gender studies. Hardy et al. (2023) identify three core theoretical mechanisms: the critical period hypothesis, positing that exposures at specific developmental stages have long-term physiological consequences; the cumulative risk model, suggesting that chronic disadvantage increases vulnerability to chronic illness over time; and the pathway or chain-of-risk model, describing connections between childhood experiences and future exposures, educational attainment, employment opportunities, and health behaviours. Women's health trajectories begin prenatally. In utero exposures including maternal nutrition, physiological stress, metabolic condition, and

environmental toxins exert long-term effects on cardiometabolic, endocrine, and immune systems. Langley-Evans (2021) demonstrated that poor maternal nutrition at crucial developmental stages disproportionately alters gene expression and metabolic control, increasing predisposition to obesity, hypertension, and type 2 diabetes in later life.

Prenatal care is therefore not only obstetric management but the initial stage of chronic disease prevention. Adolescence represents the second critical development stage, producing rapid hormonal changes and neurocognitive and psychosocial identity development. Mental health literacy in adolescence enhances resilience and long-term psychological wellbeing (Elkin et al., 2025). Early depression, anxiety, and eating disorder screening represent key trajectory modification points. Adolescent substance exposures have documented reproductive health, neurodevelopmental, and chronic disease risk implications (Ashifa, 2020). Socioeconomic background significantly affects early-life health trajectories, with structural disadvantages compounding biological risk and creating intergenerational health inequalities (Ashifa, 2021).

3. Reproductive Years and Midlife Transitions

The reproductive period is an important life phase where biological processes and social demands intersect. Women simultaneously navigate fertility planning, pregnancy, lactation, career advancement, and caregiving responsibilities. Integrated care models fulfilling these multidimensional demands must combine preventive screening, chronic disease management, mental health assessment, and contraceptive counselling within coordinated maternity services (Orshan, 2008; March, 2018). Pharmacotherapeutic decisions in reproductive-age individuals must be sex-specific, as hormonal changes influence drug absorption, metabolism, and clearance, requiring careful medication selection during pregnancy and lactation (Borgelt, 2010; Yuksel, 2011). Chronic disease prevention should begin early in adult life, with cardiovascular risk factors, obesity, and metabolic syndrome often manifesting at younger life stages.

Occupational stress and role strain disproportionately affect women managing professional promotion alongside caregiving responsibilities. Gayathri et al. (2025) demonstrate that work-life integration stress factors significantly impact women's mental health and overall wellbeing, supporting inclusion of occupational health assessment and stress management in primary care preventive frameworks. Midlife represents a crucial physiological and psychosocial transition through perimenopause and menopause. Declining oestrogen disrupts bone remodelling, lipid metabolism, vascular function, and body composition. McPhee et al. (2022)

argue that optimal bone health should be pursued from adolescence and early adulthood, demonstrating long-term fracture prevention benefits of early intervention. Menopause management requires individualised risk stratification, with hormone therapy decisions tailored to cardiovascular risk, cancer history, thromboembolic predisposition, and symptom burden. Chronic stress measurably affects brain, thyroid, and cardiovascular function during midlife (Ranganathan et al., 2024), supporting mental health screening integration into midlife preventive frameworks.

4. Ageing, Longevity, Nutrition and Structural Determinants

Women consistently demonstrate higher life expectancy than men, but longer lifespan does not always correspond to extended healthspan. Farrelly (2025) notes that longevity science must prioritise morbidity compression—maximising years of functional independence rather than simply extending survival. Older-age conditions including osteoporosis, cardiovascular disease, neurodegenerative disorders, sarcopenia, and frailty require proactive preventive intervention beginning decades before symptom manifestation (World Health Organisation, 1998). Community-based active ageing programmes demonstrate measurable positive effects on functional capacity maintenance, social wellbeing, and psychological resilience in older women (Rasi and Ashifa, 2019). Social interaction reduces isolation, mitigates depression severity, and enhances cognitive resilience. Older women demonstrate layered vulnerabilities during public health emergencies. Ashifa (2022) documents heightened crisis impact on social wellbeing, particularly for economically insecure individuals with caregiving responsibilities. Pharmacological management complexity increases in older adulthood, with polypharmacy risks and age-related pharmacokinetic changes requiring personalised medication review and deprescribing approaches (Borgelt, 2010).

Nutrition acts as an aggregate determinant of long-term health. Childhood and adolescent dietary habits produce lasting effects on metabolic, cardiovascular, skeletal, and oncologic risk factors (Langley-Evans, 2021). Lifespan-oriented nutritional counselling initiated in early life must be adapted throughout developmental stages, incorporating pregnancy, menopause, and age-related metabolic changes. Health promotion frameworks emphasise the critical role of community nurses in maintaining preventive engagement (Baker, 2023; Edwards and Layton, 2024). AI-powered patient engagement systems customise preventive care communication and improve adherence monitoring across life stages (Catherine et al., 2025). Structural inequalities persistently shape women's health trajectories. Socioeconomic disadvantage,

limited educational access, housing instability, and healthcare barriers increase risk across generations (Ashifa, 2021). Occupational health exposures for women in industrial settings carry environmental risks, ergonomic hazards, and psychosocial stressors with long-term musculoskeletal and cardiometabolic consequences (Vetriselvan and Rajan, 2019). Addressing structural determinants requires policy-level intervention including workplace protection, fair wage policies, caregiver support systems, and community-based health programmes.

5. Ethical, Policy and Research Implications

A lifespan model of women's health is grounded in principles of distributive justice. Daniels (1992) argues that just health systems must allocate resources ensuring fair opportunity across all life phases, justifying sustained investment in maternal health services, adolescent education, early chronic disease screening, menopause management, and geriatric accommodation. Policy should shift toward long-term prevention systems, with insurance coverage extended to preventive screenings, mental health services, nutritional counselling, and pharmacological monitoring across successive life stages. Grady et al. (2024) insist on interdisciplinary research models synthesising clinical medicine, behavioural science, epidemiology, and social determinant analysis to improve women's health outcomes. Longitudinal cohort research investigating developmental programming, resilience factors, and life-course transitions is invaluable for generating actionable evidence. Precision medicine offers opportunities for lifespan-specific approaches integrating hormonal profiling, genetic risk assessment, environmental exposure scores, and behavioural analytics. AI platforms can enhance predictive modelling to reveal high-risk patterns and enable customised early interventions (Devi et al., 2025), though regulation must ensure transparency, bias reduction, and equitable access.

6. Conclusion

A lifespan approach to women's health represents a holistic, prevention-based, and equity-focused model encompassing biological changes, psychosocial development, environmental exposures, and structural determinants. Health trajectories are cumulative and shaped across multiple developmental windows from foetal programming through adolescent development, reproductive transitions, midlife change, and healthy ageing. Empirical evidence supports sustained preventive engagement, sex-sensitive pharmacotherapy, integrated mental health treatment, nutritional optimisation, bone health maintenance, and structural reforms addressing socioeconomic disparities. Interdisciplinary effort, digital innovation, workforce sustainability, and policy commitment are essential for achieving equitable outcomes.

Lifespan-informed healthcare systems offer a comprehensive framework for promoting holistic wellbeing, reducing morbidity, and addressing gender-based health disparities on an international scale.

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