Review

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Maternal and Child Health and Nutrition (MCHN) Policies and Programs in Sri Lanka: A Paradigm for Public Health in Asia

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Abstract

While many low- and middle-income countries (LMICs) are struggling to achieve the sustainable developmental goals (SDG) targets, Sri Lanka stands as a unique nation which has had consistently improved maternal and child health and nutrition (MCHN) outcomes. Understanding the history and context behind successful MCHN policies, strategies and programs that enabled Sri Lanka's success can offer useful lessons to program planners and policy makers. Historical records indicate that the ancient civilization of Sri Lanka emphasized the importance of health, food security and gender equity. Although the country's welfare systems were substantially weakened by foreign invasions, Sri Lanka was always able to rebuild its MCHN systems based on evidence-informed public health policies and strategies. The involvement of local communities in the design and delivery of MCHN services partly explains how Sri Lanka has been able to achieve MCHN-related SDGs in the context of limited economic resources. In spite of the strong MCHN performance of Sri Lanka, there is still substantial room for improvement in nutrition and lifestyle behaviors within communities to address the triple burden of malnutrition observed.

Keywords: MCHN, Sri Lanka, Public health

INTRODUCTION

Maternal and child health and nutrition (MCHN) indicators reflect a country's ability to meet the Sustainable Developmental Goals (SDGs)(1). Strengthening MCHN systems in low- and middle-income countries (LMICs) is pivotal to achieve SDG 3, which in turn is essential to achieve the other SDGs (2). While many LMICs are struggling in achieving SDG MCHN-related targets, relatively

a few countries has been able to do so over the years (3–6). An example is Sri Lanka, which has had a strong and sustained political commitment on prioritizing MCH in all health-related policies and corresponding reforms and strategies over the past century.

Many influencing factors & evaluation frameworks have been identified and stipulated

in the development of health systems during the past few decades (7–9). Time trend improvements in health care delivery is highly influenced by the historical events and the socio-political and economic context of a country that is shaped over the years. Identification of LMICs that are positive outliers in their performance and studying the pathways to success should be continuous learning process in promoting health equity. However, such countries and populations are underrepresented in the formation of global health agenda as the decision making is conducted by authorities representing high income countries and the focus is stipulated on the least developed countries, yet struggling for empowerment in health.

Sri Lanka is a unique nation subjected to demographic, epidemiological, obstetric and nutrition transitions during a relatively short period of time. Hence it is an ideal context to study how the difference is created with low cost. Sri Lanka is in the fourth phase of demographic transition with a total fertility rate (TFR) of 2.2 and a crude death rate of 6.5 per 1000 population (10). Although the country has successfully controlled vaccine preventable diseases, noncommunicable diseases are in the rise, with cardio vascular diseases being a rising cause of hospital admissions (10). Sri Lanka has also reached the fourth phase of obstetric transition (11) through a dramatic reduction in maternal mortality caused by infectious diseases such as malaria and minimizing maternal deaths due to direct obstetric causes such as postpartum hemorrhage and sepsis (mainly obtained through promotion of institutional deliveries) (5). In 2015, 55% of maternal deaths were due to indirect causes such as heart disease in pregnancy and emerging infections such as influenza (12). Sri Lanka experience the triple burden of malnutrition (13,14) defined as simultaneous occurrence of undernutrition and micronutrient deficiencies as well as overnutrition characterized by overweight and obesity (15) indicating that it in the 4th stage of nutrition transition (16).

In this narrative review, we aim to describe several factors that explain Sri Lanka's success over the decades at improving MCHN outcomes. These factors include geographical, cultural, political, social, economic, and the country's rich

and unique history of equity and inclusion for over 2500 years. We expect that this compiled evidence from Sri Lanka's experience can help other countries to understand how they can achieve their MCHN outcomes through improved policies, strategies and programs in their own political, cultural, social and economic contexts.

METHODS

In this study, we integrate information from a targeted literature review of the peer-reviewed and gray literature as the methods of conducting a formal systematic review would not be productive in identifying the essential material required. Literature searches were performed to identify documents on the history of MCHN, development of MCHN and health systems, current health system and current MCHN in Sri Lanka. The child health aspects reviewed were limited to children under five years. The electronic searches included Google, Google scholar, specific websites of international non-governmental organizations such as World Health Organization (WHO), United Nations International Children's Fund (UNICEF), Food and Agricultural Organization (FAO), The World Bank and Sri Lankan ministry of health and institutional websites such as the Department of Census and Statistics, the Family Health Bureau and Epidemiology Unit. Keywords and phrases included the common terms; "maternal health", "child health", "nutrition", "food security", "health systems", "health system development", "primary health care", "history of health", "health policies", "nutrition policies" and their covariate terms combined with "Sri Lanka". Specific search terms were used to retrieve information on specific programs, guidelines and circulars. The data was obtained through main data sources, including books, journal articles, national survey reports, global health reports and supplementary sources such as policy documents, national guidelines, circulars, and webpages of health institutions and organizations. The manual search included local historical records, which were not available in electronic databases including library catalogues. Table 1 represents the different types of information sources identified. Data extraction was performed with relevance to the themes mentioned in Table 1. The most updated

information was used to describe the current MCHN status of the country and the interpretation of the information extracted was safeguarded through consensus among the authors.

Geography, population and key socio-economic indicators

Sri Lanka is a tropical island with an area of 65,610 square kilometers. The country has 21.6 million inhabitants living in urban (18.3%), rural (77.3%) and estate (i.e., populations living in plantations, 4.4%) areas. The majority of Sri Lankans are Sinhala Buddhists (around 70%), and the minority

populations identify themselves as Tamil, Moor and Burger (73). The Gross National Income (GNI) per capita is USD \$3892 (75). Less than 4% of GNI is spent on health service provision (76). The average life expectancy at birth for Sri Lankans is 75.5 years. The literacy rate of males and females are 93.6% and 91.7%, respectively (25). More than 90% of the population has access to safe drinking water and sanitation (25). The Household Gini coefficient Index is 39.8, ranking Sri Lanka in the 61st place in inequities among 121 LMICs (78), reflected in only 4.1% of the population living below the national poverty line (79).

Table 1: Data sources reviewed on current status and development of MCH and nutrition in Sri Lanka

Theme	Books	Journal articles	Policy documents	National reports/surveys/Guidelines/ circulars	Global reports	Web pages
Maternal and child health, Sri Lanka	Immunization Handbook, Sri Lanka 2012 (17) Hibbs HH 1916 (18)	Abouzahr C 2013(4) Senanayaka et al 2011((6) Souza J et al 2014 (11) Agampodi T 2019 (19) De Silva CC 1956 (70)	Sri Lanka code for the promotion of breast feeding and marketing breast milk substitutes and related products 1983 (21) National Maternal and Child Health Policy 2012 (22) Population Reproductive Health Policy, Sri Lanka 1998 (23) National Policy on Early Childhood Care and Development 2017(24)	DHS Sri Lanka 2016 (25) Maternal death surveillance 2015 (12) National Guidelines for Maternal care (2015) (26) National guidelines for Newborn care (2014) (27) National Feto-Infant Mortality Surveillance Mechanism (2016) (28) Guideline on Child Development Promotion and Development Screening for Primary Health Care (PHC) Workers; General circular:01/12/2020 (29)	WHO, National Implementation of the Baby Friendly Hospital Initiative 2017 (30)	Family Health Bureau statistics 2018 (31) WHO 2019 News release (32)
Maternal and child nutrition and food		Senerath u et al 2012 (33) Naotunna C 2017 (34) Pallewatta P 2019 (35)	National Nutrition policy 2010 (41)	DHS Sri Lanka 2016 (25) National Nutrition and Micronutrient Survey of Pregnant Women in Sri	WHO 2018, Global nutrition report (13) Levels and Trends in	World Breastfeeding Trend initiative 2020 (54)

security, Sri Lanka		Dharmasoma U 2020 (36) Aguayo VM 2017 (37) Akhtar S 2016 (38) Akseer N 2015 (39) Sirasa F 2020 (40)		Lanka. 2017 (42) National Nutrition Survey of Lactating Women in Sri Lanka 2017(43) National nutrition and micro nutrient survey part 2 2014 (14) Management of severe acute undernutrition and moderate acute undernutrition of children under five years of age; Manual for health care workers 2019 (44) National strategy for infant and young child feeding 2015-2020 (45) Revised Schedule Vitamin A mega dose 2009 (46) Infant and Young Child Feeding Guidelines 2007(47) Iron Supplementation circular 2016 (48) Zn supplementation in diarrhoea. General circular 2013 (49) Selection of Thripasha beneficiaries and distribution of Thripasha 2016 (50)	Child Malnutrition 2020 (51) FAO 2016, Methods for estimating comparable rates of food insecurity experienced by adults throughout the world (52) World Food Program Crop and Food Security Assessment 2017 (53)	
Current health system of Sri Lanka	Hemachandra N 2011(55) Perera S 2015 (56)	Kumar R 2019 (3) Jayarathna K 2014 (37) Agampodi S 2014 (52)		Annual Report on Family Health 2017 (57) Maternal Death Investigation and Surveillance system, Sri Lanka (58)	WHO Primary health care systems 2017 (3)	Family Health Bureau, Maternal Care Unit (59)

Development of modern health system Sri Lanka	Lokubandara 1990(60) Uragoda C.G. 1987 (61) Hewa S 1995 (62) Wickramasinghe N 2006 (63)	Seneviratne et al 2000 (4) Jones M 2015 (25) Hewa S 2011 ¹ (27) Hewa S 2011 ² (28) Perera S 2016 (40) Wikramasinge SC 2012 (48)		Resource Mobilization in Sri Lanka's Health Sector 1997 (64) BF code implementation-health care workers 2012 (65)		De Soyza Hospital for Women, Colombo 8 (66) United Nations Sri Lanka (67) Epidemiology Unit, Sri Lanka, National Immunization Programme (68) National Institute of Health Sciences, Kalutara (69)
Ancient maternal and child health services Sri Lanka	Narayan RK 1976(70) Mahawanshaya (71) Saararathana Sangrahaya	Gamage U 2018(72)				
General				Sri Lanka labor Force Survey 2017 (73) DHS Sri Lanka 2016 (25) Economic and social statistics in Sri Lanka 2019 (13) Annual Health Bulletin 2017 (10)		Department of Meteorology SL (74) World Bank new country classification (75) WHO global database on health expenditure 2017 (76) United Nations world population prospectus 2019 (77)

Key maternal and child health and nutrition outcomes

The maternal mortality ratio (MMR) in Sri Lanka was 36/100000 live births in 2019 (31), which ranks 4th among the 50 lower middle income countries. Early registration of pregnant women

in the maternal care program (79% enroll before eight weeks of pregnancy) and regular antenatal care, including nutrition counseling and other nutrition-related series, are enabled through formal policies implemented through the public health system (22) which serves all pregnant women in Sri Lanka. The high coverage is also reflected in terms of quality of services, as 99.3% of pregnant women in Sri Lanka attend at least four antenatal care visits. Furthermore, mothers universally deliver in institutions with skilled birth attendants (99.9%) (25). Sri Lanka's neonatal mortality rate of 6.5, infant mortality rate of 10 and an under-five mortality rate of 11 per 1000 live births highlight the country's relatively good health sector performance, especially taking into account the rates of declines over time, with key early life MCHN outcomes (25) (Figure 1). Sri Lanka has performed exceptionally well protecting, promoting and supporting breastfeeding; hence, it is not surprising that it was the first country classified as the only 'green' breastfeeding country by the World Breastfeeding Trend initiative (WBTi) in 2020 (54). More than 90% of newborns initiate breastfeeding early; i.e.,

within the first-hour of birth. The prevalence of exclusive breastfeeding at 2-3 months was 84% and at 4-5 months, it was 64%, according to the Demographic and Health Survey 2016 (25). In spite of these positive MCHN outcomes, much work remains to be done as the triple burden of malnutrition - defined here as the co-existence of undernutrition (e.g., underweight), overnutrition (overweight/obesity) and iron and other micronutrient deficiencies is a relatively new challenge in the country. Among pregnant women, 16.6% had a low Body Mass Index (BMI) and 25.6% were overweight or obese (31). The prevalence of anemia in pregnancy was 25.3%. Mean maternal weight gain during pregnancy was 9.4 kg (43), and the prevalence of low birth weight was 15.7% (31). The prevalence of stunting, wasting and underweight of children under five were 17.3%, 15.1% and 20.5%, respectively (25). The nutritional indicators in children follow a pattern of strong social inequities, especially across urban, rural and estate sectors likely as a result, at least in part, of food insecurity and poor dietary patterns (42).

Figure 1: Trends in maternal and child health indicators, Sri Lanka

Historical development of health systems, policies and programs

Evidence of ancient health systems, maternal and child care, gender equity and food security

Existence of a good health system is a key for the provision of maternal care. Sri Lanka has had a well-organized health system from ancient times. Health received the priority of the rulers' even at the very beginning of Sri Lankan history.

The ancient history of Sri Lanka encompasses a period of the pre-historic ruler Ravana (8000 Before Present) (70) during which, great advances in science and medicine were described. The written history documents that the ancient kings had prioritized the welfare of people through improved health, education and food security. The first written record on the establishment of a

maternity home and hospital dates back to the era of king Pandukabhaya (437-367 BC) (72). Later, King Dutugamunu (161-137 BC), Buddhadasa, Sena II (853-887 AD), Upathissa II (517-518 AD), Dappula II (815 -831AD), Kashyapa IV (898-914 AD) and Kashyapa V (914-923 AD) are also mentioned to have built hospitals (71,80). Ruins of some of these hospitals have been identified across the country in places such as Anuradhapura, Mihintale, Medirigiriya and Polonnaruwa and remains show that they had inward facilities, sanitary facilities (toilets, bathrooms), facilities to make and store medicine and perform surgical procedures (80) (Figure 2).

Figure 2: Ruins of the ancient hospital at Mihintale, Anuradhapura.

According to Mahavamsa, the best known ancient chronicle of Sri Lanka, the healthcare institutions were governed by written bylaws (Eg: Medirigiriya) which were continued/updated over the reins of different kings(81). The institutions received income from the harvest of lands allocated for them for this purpose. Doctors were paid by the regime and they were prohibited from gaining any monetary or other gains from villagers (81,82). Provisions were available for medications (80,81) under the regime. Therefore, it can be assumed that the health care was mostly free. This is further supported by the Buddhist values that support caring for sick people for the merit of the act. An entire health system has been described in Mahavamsa. King Buddhadasa (341-370 AD) established an organized health system throughout the country. One hospital with salaried doctor/s was established for a catchment area of 10 villages. Furthermore, 5 % of the government tax income from the catchment area was allocated for the maintenance of the hospital, suggesting that the health care was free of charge (72). Further evolution of the health system in Polonnaruwa era shows that a chief doctor ('Maha Wedana') represented the court of the King Parakramabahu I (10th Century AD) (80). There are evidence that medications and social protection such as food, lodging, clothes and supplements were also provided to the sick and pregnant women by the under the regime (e.g.: Dappula II, Upathissa I) (71).

Evidence on maternal care facilities was supported by the same sources. King Pandukabhaya is believed to have supported the construction and operation of a maternity home ('Shivikasala') for the City of Anuradhapura (61). King Dutugamunu had provided salt and chilies for pregnant women and also provided the 'Raja Prasada' (appreciations) for the service of birth attendants (83,84). These must have been done on a grand scale as they are mentioned in Mahavamsa, which had been written about two centuries later. King Buddhadasa, 'the doctor' had written a summary of patient management guidelines called 'Waidyaka Sarartha Sangrahaya', which describe rituals, medicines, and procedures for pre-pregnancy, antenatal, intranatal and

postnatal care of pregnant women (71). Maternal care and gender equity were prioritized in Sri Lanka since the times of ancient royalty (Figure 3). Health care was rather 'universal' during this period, as evident from the incident the king treating a Chandala clang woman (ranked lowest in social hierarchy) who had lost seven pregnancies (71). King Upathissa I (365-406 AD) had built 'halls with wealth' for the welfare of pregnant women (71). A maternity home in Polonnaruwa is also mentioned in the era of King Parakramabahu I. The sponsorships for maternity care was not limited to the regime. During the era of Kashyapa IV, Senal Nakan, a secretary to the king, had constructed a maternity hospital and which facilitated this with allocations for its maintenance by the regime. These historical records illustrate that the recognition of maternal care as a concern for the medical sector and that medical care should be minimally restricted by social inequities has been engrained in Sri Lanka's society since ancient times.

Figure 3: Ancient historical timeline indicating maternal health services

Sri Lanka also had an organized education system in ancient times, which was provided free of charge. Education was open to females, illustrating the gender equity as per the teachings in Buddhism. Women were allowed to reach both materialistic (education) and spiritual accomplishments (supreme mental states). Women were able to teach it to others (84), become monks, become ruling monarchs for the country or regions (e.g.: 'Rajini' position held by princesses) (84), own property (evident by donations to temples) (81,84), engage in paid occupations (e.g.: positions and payments mentioned in Mihinthala slate inscriptions of King Mihindu IV)(82), become poets and travellers (e.g.: about 9 to 12 poems among infamous Sigiri poems were written by women travellers) (60,84).

In ancient times, Sri Lanka was a prosperous country where the production of food exceeded its population needs. Indeed, during the King Parakramabahu the Great era (1164-97 AD), the country was known as the "granary of the East" and exported rice. However, the repeated regional foreign invasions that occurred several times during the periods of feeble kings and the European colonial invasions, disrupted the original strengths of the Sri Lankas' health, education, prosperity and social values (61). In 1505, the Portuguese invaded the coastal areas of the island followed by Dutch (1640) and British

(1796). Sri Lanka obtained independence from the British colonial ruling in 1948 and since the 1930's invested heavily in setting up "modern" MCHN policies and programs.

Development of the modern health systems for MCHN during the colonial and post-independence period

The Portuguese and Dutch ruled only the coastal areas of Sri Lanka and built hospitals to serve their armed forces, shipping personnel and nationals. In the British colonial period, hospitals were first established on philanthropic grounds. In 1858, the Civil Medical Department was established to provide medical services for the military and plantation sector (61). The establishment of the Colombo Medical School in 1870 trained the professionals that initiated universal health services during the critical period culminated with the country's independence in 1948 (85). The first maternity hospital, the De Soyza Lying in home - the second maternity hospital in Asia - was founded by the philanthropist Charls Henry de Soyza in 1879 (66). The first midwifery training school was established in 1881, and in 1905 the first cesarean section was performed in Sri Lanka. The first antenatal clinic in Asia was established in Sri Lanka in 1921 (5) (Figure 4).

Figure 4: Modern historical timeline indicating establishment of maternal and child health services

The health unit system, the public health administrative units that conducted routine preventive care and field-tested public health interventions, was established in 1926, which is one of Sri Lanka's greatest successes. Introduced by the International Health Board (IHB) of the USA Rockefeller foundation (23), the first health unit in Sri Lanka was established in 1926 in Kalutara-Thotamune by IHB member Dr. W.P. Jackoks and Dr. S.F. Chellapa, a Sri Lankan health expert (87). The health unit system undertook health-welfare activities, including health education, sanitation and control of communicable diseases. Establishing health units was based on a 'selective' primary health care concept where the health problems addressed were based on the priorities in the areas. The Medical Officer of Health (MOH) in charge was an experienced senior medical doctor with special training on public health. He managed a team consisting a public health nurse, a public health midwife, a sanitary inspector and a clerk. Community participation was prioritized in health units' work. Health units worked together with a number of community organizations, local government authorities and individuals. Assessing community perceptions, made it easier to disseminate health knowledge and to attract donations for health service provision. Conducting surveys and recording relevant statistics on births, infant and childhood mortality and morbidity including communicable diseases, immunizations and conducting mass treatment campaigns such as for

tuberculosis and typhoid and producing health reports were its important functions (87). To address the increasing demand for extending the coverage of health units to the other parts of the country, the public health staff training center established in 1926 in par with the first health units, was upgraded to the National Institute of Health Sciences, Kalutara (in 1979) which now serves as the main center for public health staff training in the country (69). The health units served as a sustainable blueprint providing universal health coverage in Sri Lanka.

In 1931, the Donoughmore constitution guided Sri Lanka's political system through two decades of self-government prior to independence. Due to universal suffrage, politicians were committed to expand health services in order to obtain vote (85). The epidemic of Malaria in 1934-35 led to further expansion of hospitals as well as health units to rural areas. Social policies played a priority in the democratic governance of Sri Lanka, leading to the adoption of universal policies for food subsidies in 1943, free education in 1945 and free health care in 1951.

Provision of uninterrupted and improved coverage of health services followed after independence (Table 2). International Non-Governmental Organizations (INGOs), UN agencies, and international development agencies were welcomed in Sri Lanka since their early years (1945, Food and Agricultural Organization; 1953, Family Planning Association; 1956, World Health

Organization (WHO), United Nations International Children's Emergency Fund (UNICEF and The World Bank) (67). Over the years, the relevant global health initiatives were promptly introduced to Sri Lanka, culturally adapted and implemented with strong government commitment via its' well-established health systems (Table 2). The resulting Sri Lankan Expanded Program of Immunization (68), Maternal Care Program

(22,57), maternal death investigation and surveillance system (28) and promotion of breastfeeding (16) are considered to be the best practice model that is affordable and implementable in LMICs. As a result of its efforts at furthering international cooperation, Sri Lanka developed and continues to benefit from solid global and local technical well-funded networks to advance MCHN in the country (89).

Table 2: Sri Lanka's maternal and child health policy and program milestones after independence

Year	Milestone
1965	Family Planning policy and of family planning services were strengthened by incorporating them into MCH program (5)
1968	Establishment of Family Planning Bureau (current Family Health Bureau (FHB)) for coordinating all MCH services(31). FHB is the focal point in the Ministry of Health that coordinates MCH services in Sri Lanka, including policy and guideline preparation, in-service trainings, and MCH data surveillance.
1978	Establishment of National Expanded Program of Immunization (EPI)(68) Established by the 1886 Vaccination Ordinance (in response to small pox), the immunization activities that followed for decades were streamlined under a universal coverage established by the EPI Sri Lanka in 1989 (17). Sri Lanka vaccines programme has eliminated many childhood preventable diseases including polio and measles and have controlled rubella infection(32).
1977	Population Policy focused on expansion of modern and permanent family planning methods (5)
1981	Sri Lankan WHO Code for Promotion of Breast Feeding and Marketing Breast Milk Substitutes and Products (revised in 1998 & 2002) (21)(65) The Sri Lankan government initiated action in promotion, protection and to support BF.
1982	Primary Health Care Concept enabled favorable health reforms in the already available primary health care system in Sri Lanka (56).
1987	Establishment of Maternal Death Investigation System(58,88)
1989	Decentralization of Health Services
1993	Establishment of Baby Friendly Hospital Initiative (30)
1994	Reproductive Health Concept was incorporated into MCH services (5)
1996	Establishment of Well Women Clinic services for screening for noncommunicable diseases of women >35 years of age (22)
1998	Population Reproductive Health Policy was formed (23)
2002	Development of food based dietary guidelines for Sri Lanka (revised in 2011) (90)
2004	Incorporation of Early Childhood Care and Development (ECCD) into MCH program revision (2017) (24)
2005	Establishment of Lactation Management Centers at hospitals to support early breastfeeding (91)
2007	External review of MCH program by the WHO (55)
2007	Nutrition Rehabilitation Program (NRP) was first conducted for secondary prevention of severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) of children under five years in selected provinces, made universal in 2012,

	guidelines revised in 2017/18 (44)
2010	Incorporation of Infant and Young Child Feeding guidelines into Sri Lanka's national nutrition policy (22,41)
2012	Revised Maternal Care package & establishment of comprehensive preconceptional care (55)
2013-15	Development of national guidelines for maternal care (26)
2015	Development of national strategy for infant and young child Feeding in Sri Lanka (45)
2014	Establishment of national guidelines for Newborn Care (27)
2016	Establishment of national guidelines for fetal and infant mortality surveillance mechanism(59)

Current maternal and child health preventive health care system

The current preventive care system is a strong model enabling the sustainability and implementation of new programs for maternal and child health promotion. There are 381 divisional health administrative units in Sri Lanka (MOH areas). Currently, MOH in charge (each for

a population of 60,000) is supported by an additional MOH and staff consisting of a public health nursing sister, supervisory public health midwives, public health midwives (PHM) (each for a population of 3000), supervisory public health inspectors (SPHI), public health inspectors (PHI) (each for a population of 10000), and office staff (3) (Figure 5).

Figure 5: Structure of MCHN services network, Sri Lanka

the PHM around 6-8 weeks of conception. Those exerting no current risk factors (as assessed by the MOH) receive three domiciliary visits by the PHM, attend nine clinics, three antenatal sessions and are referred for specialized care and ultrasound scan at 18-20 weeks of gestation. Pregnant women with risk factors are referred to specialists and receive 'shared care'; i.e., primary care and specialized care (Figure 6). After the delivery, PHM visits the mother at home four times and mothers attend the postpartum clinic four weeks after delivery (22,55).

*Pregnant women having a risk condition will have more domiciliary visits by the PHM and will be reviewed more frequently in the antenatal clinics

The electronic web based reproductive health management information system (e-RHMIS) (converted to the electronic system in 2017)

transfers all relevant health information from peripheries to the central ministry via this preventive health network (31). The RHMS is a mechanism providing information for self-evaluation at various levels of the health system. The data flow starts from the officers of PHMs and field clinics daily. At the end of each month, the monthly summary is sent to the MOH office. At the MOH office, data from all PHM areas are entered into the e-RHMS system. The RHMS denotes universal coverage enabling regular availability of MCHN indicators (57).

Maternal and child nutrition-oriented interventions in Sri Lanka

The main ongoing nutrition intervention programs in Sri Lanka include integrated maternal and child nutrition program, food and micronutrient supplementation programs and food subsidies and poverty alleviation programs (41). Nutrition education and counseling are delivered at pre-conceptional, and antenatal sessions in child welfare clinics and child weighing posts. Micronutrient supplementation is incorporated to the MCH services. Folic acid is given to pre-pregnant and pregnant women, up to 12 weeks of gestation. The maternal care program offers micronutrient supplements (iron, calcium, vitamin C and folic acid) throughout pregnancy and postpartum. Vitamin A megadose is given to mothers at discharge and for children from 6 months onwards up to five years. Iron and micronutrients are supplied for all babies born preterm and with low birth weight with BF and for all infants and young children after six months. Zinc supplementation for children during and after diarrhea is practiced (92). Nutritional food supplement ('Thripasha') is supplied to all pregnant and lactating women and children with underweight and the "food basket" is given to all pregnant and lactating mothers. Under growth monitoring and promotion, all children with Severe Acute Malnutrition (SAM) (weight for height < -3SD) are referred to a pediatrician and managed in the hospital with appropriate ready to use therapeutic food (RUTF). Children with Moderately Acute Malnutrition (MAM) (weight for height between -2SD to -3SD) are carefully followed up and managed at the field child welfare clinics (44).

Impact of MCHN system in Sri Lanka

Modern Sri Lanka is built upon a history and a civilization favoring promotion of universal welfare, gender equity and a strong health system. Sri Lanka's historical context enabled it to improve MCHN outcomes to a greater extent and over a shorter period of time in comparison to other LMICs. As shown above, it is truly remarkable that the MMR, which was around 2,300 per 100,000 live births in 1911, was reduced to 32 per 100,000 live births by 2018 (31). The infant mortality rate which was 189 per 1,000 live births in 1906-10 (18) was brought down to 10.1 per 1000 by 2019 (31). Currently, malnutrition related mortality is relatively low in Sri Lanka. Sri Lanka experiences the lowest MMR and under five mortality (11 per 1000 live births) in the south Asian region (regional average of under-five mortality 43/1000 live births) (39). The high coverage indicators of skilled attendance at birth and of immunization in children demonstrated in all wealth quantiles represents health equity achievements compared to the other south Asian countries (39). Sri Lanka has been identified as a model for steady improvement on MCHN services despite the low resources and declining investment and cost mediated for the services (93).

Moving forward

Sri Lanka is now in the fourth phase of obstetric transition defined as presence of low maternal mortality comprised by indirect causes of maternal deaths. For this reason, the country needs to continue improving its quality of services through social development strategies that put front and center MCHN, minimizing over-medicalization, and addressing the rising burden of non-communicable diseases (11,55). When the WHO International Classification of Diseases related to Maternal Mortality (ICD-MM), which include all suicidal deaths as direct maternal deaths, is adopted, suicide was identified as the leading cause of maternal deaths in certain areas of the country (94), reflecting the need for strengthening perinatal mental health as part of the strategies to prevent maternal deaths. This would be a challenge as pre-existing social capital

in pregnancy in the majority rural Sri Lanka that exert protection towards mental wellbeing (19,95,96), will be impaired with the due social transition. With the inevitable social transition, growing educational demands, especially among females, may damage the naturally existing support for the MCH and nutritional programs. Further, social development and addressing overmedicalization has not been prioritized in the current political agenda and the actions taken to prevent NCDs have slow progress and need to be strengthened. The country needs to prioritize ECCD with a strong intersectoral approach with appropriate evidence-based interventions in education and social service sectors in par with the “nurturing care” concept. Measuring early child development need to be incorporated in addition to promotion in a stronger manner.

The relatively high level of household food insecurity is a major area to focus on moving forward following an intersectoral approach through an equity lens (52). This is key because poverty in selected geographical pockets, seasonal variation of food production, and low diversification of livelihoods are the main drivers of food security in Sri Lanka (53) in the context of intra and inter district food and nutrition security inequities (97). Addressing sub optimal infant and young child feeding behaviors (43) and poor dietary diversity (40) should be strong priorities with the existing triple burden of malnutrition. The country needs to identify context-specific problems of the food system, food security and dietary behaviors and formulate guidelines based on evidence generated within the Sri Lankan community (98). In par with these it would be beneficial for Sri Lanka to excavate and promote local practices of healing and health promotion which prevailed during centuries.

CONCLUSION

The key lessons learned from the successful Sri Lankan experience and persisting challenges that other LMIC's countries can benefit from are: high-level political priority for maternal and child health services, universal public health system coverage, implementation of evidence-based strategies for disease prevention and health promotion in a culturally appropriate manner,

and cultural and social values emphasizing gender equity and protection of mothers and children. In spite of the strong MCHN performance of Sri Lanka, the child malnutrition inequities documented in this review indicate that there is still substantial room for improvement in the country, especially with regard to the protection of the food and health security of low-income families with infants and young children. The country also needs to be aware of the sustainability of MCHN services with the anticipated socio-demographic changes.

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Conceptualization: TA, RPE. Data curation and interpretation: TCA, GSA, NDW, JNW, SBA. Methodology: TCA, NDW, SBA. Visualization: TCA, GSA, SBA. Writing original draft: TCA, GSA, JNW. Writing-review and editing: RPE, NDW, SBA, JNW. All authors approved the final version of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that the questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflicts of interests

Authors have no conflicts of interest

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