

Original Research Article

A causal model of the continuum of care for maternal, newborn, and child health in Myanmar: a structural equation modeling approach

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Received: 18 March 2022

Accepted: 13 April 2022

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ABSTRACT

Background: Incredible drop in global maternal mortality ratio (MMR) and neonatal mortality rate (NMR) is still far from sustainable development goals (SDGs) targets. Applying the continuum of care (CoC) concept reduces mother and newborn deaths. We determined the influencing factors of the continuity of maternal, newborn, and child health care (MNCH) services from pregnancy to child immunization with structural equation modeling (SEM) to continuously improve health outcomes and MNCH service utilization.

Methods: We included 1,669 pair samples of mothers and their children under 24 months from (2015-2016) Myanmar demographic health survey (MDHS) data. We used STATA software (version 14) for all analyses. We evaluated the relationships between four latent independent constructs-characteristics of the individual, household, socio-economic, and child and four latent dependent constructs of CoC components- utilization of antenatal care (ANC), delivery, postnatal care (PNC), and vaccination programs using SEM approach.

Results: Adequate utilization of ANC, delivery, PNC, and child immunization along the MNCH pathway were 19.7%, 44.8%, 21.8%, and 30.6%, respectively. SEM analysis shows that socio-economic status influences all CoC care components. Moreover, the receiving ANC favors the utilization of subsequent components of delivery, PNC, and vaccination. However, receiving delivery care favors only PNC utilization but not childhood vaccination. In addition, PNC utilization does not affect childhood vaccination.

Conclusions: The quality and coverage of ANC is the most crucial factor in establishing the care continuum of MNCH services in Myanmar. The overall socio-economic development of the nation will alleviate the inequity in health access.

Keywords: CoC, Maternal, Child health, SEM, Demographic and health survey, Myanmar

INTRODUCTION

Worldwide, about 295,000 women die annually due to the consequences of gestation and childbirth.¹ Low-income and lower-middle-income countries accounted for 94% of these deaths. An estimated 86% of maternal deaths (254,000) occurred in Sub-Saharan Africa and Southern Asia. Although global MMR declined by about 38%

between 2000 and 2017, it is still far from the SDGs targets. Globally, children under five years deaths were 5.9 million deaths in 2015, in which neonatal death was accounted for 2.7 million.²⁻³ MMR in Myanmar was 250 per 100,000 live births (LB). In contrast, the neonatal mortality rate (NMR) was 23.1 per 1,000 LB.⁴ Despite being remarkable declines of MMR and NMR, they are still in elevation in the region. The current reproductive health status in Myanmar needs to be improved further.⁵

Most mother and newborn deaths can be prevented if the current MNCH services apply the CoC approach.^{6,7}

CoC has been accepted as a fundamental approach to decrease maternal and neonatal deaths and upgrade their health and welfare.⁷⁻¹⁰ CoC provides maternal care before gestation through antenatal, intra-natal, and postnatal periods and child care from the neonatal period to adolescence. CoC links the gaps of MNCH and saves most of their lives since healthcare needs are interrelated.¹¹⁻¹³ The main principle of the CoC is that every stage is intensely interweaved, with the accomplishment of each step constructing on the earlier step.¹⁴ However, it becomes the main challenge of inadequate resource setting. A study conducted in 75 prioritized countries found that receiving four times antenatal care (ANC) was only 55%, whereas skilled birth attendance rate (SBA) was 65%, and 58% of mothers and 28% of newborns received postnatal care (PNC) between 2009-2014.¹⁵ According to the MDHS (2015-2016), mothers who received at least four ANC contacts were 58.6%, gave birth by SBA was 60.2%, and received postnatal check-up within two days postpartum was 71.2%.¹⁶

To improve the MNCH outcomes by operating CoC, identifying the level and extent of factors contributing to MNCH services is essential. In Myanmar, many quantitative and qualitative studies have been conducted about ANC, SBA, PNC, and child immunization separately.¹⁷⁻²⁵ None of these studies provide information regarding the continuity of MNCH care services. One study conducted the relationships between CoC of mothers and immunization status of their children.²⁶ However, this study did not explore the holistic view of the CoC pathway to get information about the gaps of care utilization along the way of CoC. The influencing factors of the level of continuity of MNCH services are still unidentified. Hence, we conducted this study to investigate the influencing factors of the continuity of MNCH services from pregnancy to child immunization following the conceptual model of a study conducted by Owili et al during 2016.²⁷

METHODS

We used data from the 2015-2016 MDHS, a population-based household survey providing nationally representative samples of 14 states and regions and the Nay Pyi Taw Union. The detailed methodology had been published elsewhere.¹⁶ In brief, it used the two-staged stratified sampling method; enumeration areas were clustered as the primary sampling unit, whereas households as a secondary stage. The survey selected 13260 households by randomly choosing the 30 households from each of 442 clusters, including 123 clusters from urban and 319 clusters from the rural area. From the selected households, trained enumerators interviewed 12,885 reproductive-aged women using the revised Women's questionnaire of the DHS program. We

included 1,669 pair samples of mothers and their children under 24 months in this analysis since DHS collected information of PNC only for mothers who gave live birth two years preceding the survey to avoid recall bias. See the detailed study flow diagram in Figure 1.

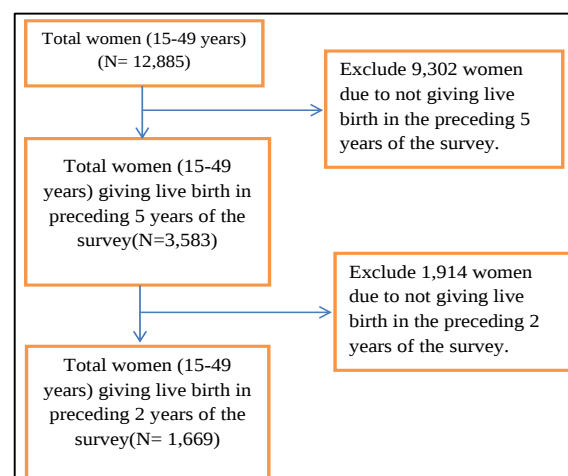


Figure 1: Flow diagram showing the selection procedure of samples.

Concept and description of the CoC model of MNCH

Owili et al adopted the model of the CoC of MNCH from the World health report (2005), i.e., the utilization of MNCH care at pregnancy, childbirth, postnatal period, and infant time, and we reproduced their model in our study.²⁷ In this model, each utilization of MNCH care depends on individuals, households, socio-economic and children. In addition, the utilization of early-stage also affects that of a later stage. The model describes the possible relationships between four latent independent constructs: characteristics of an individual, household, socio-economic, and child, and four latent dependent constructs, which are the utilization of antenatal, delivery, postnatal care, and vaccination programs (Figure 2).

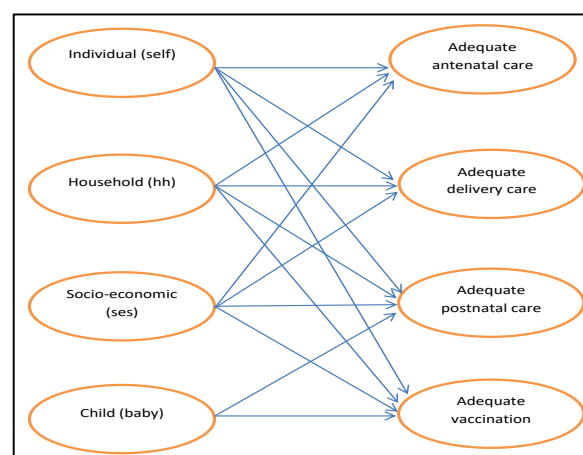


Figure 2: Conceptual model of continuum of care for maternal, newborn, and child health (adopted from Owili et al).²⁷

Latent dependent constructs

We used the individual recode file (IR) of MDHS data. We checked the missing data and generated some new variables. Four latent dependent constructs were adequate utilization of antenatal (anc), delivery (del), postnatal care (pnc), and vaccination (vaccine). We measured these constructs using observed variables changing to dummy variables (0=No and 1=Yes). These observed variables are the same as those used in study of Owili et al.²⁷ Except polio because of no polio vaccination at birth in Myanmar.

We measured adequate ANC utilization latent construct by six observed variables. These were 1) received ANC (anc_rec), 2) received four or more ANC (anc_4), 3) received initial ANC in the first trimester (anc_tri), 4) received ANC with a skilled person (anc_skill), 5) received ANC at the health facility (anc_fac), and 6) received all seven components (knowledge of pregnancy complications, blood pressure, tetanus toxoid, iron, deworming, blood test, urine test) of ANC (anc_comp).

We used the delivery information i. e.; delivered at the health facility (del_fac), delivered by a skilled person (del_skill), and delivered with cesarean section (del_cs) to assess the adequate delivery care. For adequate postnatal care utilization, we evaluated whether the mother received a postnatal check (pn_rec), mother received a postnatal check within 1st day (pn_1stday), mother received a postnatal check by a skilled person (pn_skill), newborn received a postnatal check (bb_rec), newborn received a postnatal check within 1st day (bb_1stday).

We used the children's information of receiving eight vaccines, including three poliomyelitis vaccines (polio1, polio2, polio3), Bacille Calmette Guérin vaccine (bcg), three diphtheria, pertussis and tetanus vaccines (dpt1, dpt2, dpt3), and measles (measles) vaccine to measure the latent construct of adequate vaccine utilization.

Latent independent constructs

The latent independent variables were characteristics of the individual and family (self), household (hh), socio-economic status (ses), and child (baby). We used the marital status of the mother (marital), age group of the mother (agegp), child's birth order (b_order), number of household members (hh_mem), under5 children number (u5_num), and women empowerment (empower) for latent individual construct. We determined the women's empowerment level using their decision-making ability regarding their health, large household purchases, and visits to family and relatives. If women could not involve in decision-making for those activities, we categorized them as having no empowerment. At the same time, we assumed empowerment if they took part in decision-making in these activities.

We used geographical zone (zone), residence (residence), and access to health facilities (access_hf) to assess the latent household construct. There were four zones, including hilly (Chin State, Kachin State, Kayah State, Kayin State and Shan State), coastal (Mon State, Rakhine State and Tanintharyi Region), delta (Ayeyarwady Region, Bago Region and Yangon Region), and central plain (Magway Region, Mandalay Region, Nay Pyi Taw and Sagaing Region).

We assessed the latent socio-economic construct using six observed variables. These were mother's educational status (m_edu), mother's occupation (m_occu), father's educational status (f_edu), father's occupation (f_occu), wealth index (w_index), and mass media contact (TV, radio, newspaper) at least once per week (mm_expo). We measured the latent child construct by the child's size at birth (bb_size), sex (bb_sex), and age in the completed year (c_ageyr) and age group (c_agegp).

Our study added women empowerment and access to health facilities variables for latent exogenous constructs. In addition, we categorized the zone variable according to our geographical area instead of the country and region variables used in the study of Owili et al.²⁷

Data analysis

We conducted SEM analysis to assess the complex relationship between latent dependent constructs of the CoC components and latent independent constructs. The analyses were done using sampling weight and survey data analysis command (svy) to get the nationally representative findings. We used STATA software (version 14.0) for all analyses. We used a frequency distribution table to describe the background characteristics of the study population and the Chi-square test of independence for the association between the CoC components and background characteristics. We calculated the linear combination score for each latent construct using the respective observed variables during SEM analysis. We built and tested the hypothesized model using these scores. We assessed the model fitness using weighted χ^2 goodness-of-fit tests and (RMSEA) as absolute fit indices. Model fit was determined if RMSEA value (<0.1).²⁸ When the model fit was proper, the parameter estimates were tested and expressed ratio with its standard error using z statistic at 0.05 significant levels when its value surpassed 1.96 and at the 0.01 level when its value surpassed 2.56. When the model fit was improper, the model was revised by correcting a specified and estimated model by either freeing fixed or fixing parameters that were free.

RESULTS

We reported the frequency distribution of background characteristics of the study population in Table 1. Moreover, we also described the bivariate analysis of background characteristics with adequate utilization of

the CoC components in this Table 1. Only 19.7% of women received adequate ANC. Bivariate analysis shows that mother characteristics (age, child's birth order, number of under-5 children), household characteristics (zone, residence, accessibility to health facility), socio-economic characteristics (education of mothers and fathers, fathers' occupation, wealth index, mass media exposure), child characteristics (birth size) were significantly associated with adequate ANC utilization.

We also found that about 44.8% of women received adequate delivery care. The mother characteristics (child's birth order, number of under-five children), household characteristics (zone, residence, accessibility to health facility), socio-economic characteristics (mothers' education, mothers' occupation, fathers' education, fathers' occupation, wealth index, mass media exposure) and child characteristics (birth size) were significantly associated with adequate delivery care utilization. Women who received adequate postnatal care were only 21.8% of study population. Mother characteristics (child's birth order, number of under-five children), household characteristics (accessibility to health facility), and socio-economic characteristics (mothers' education, fathers' education, wealth index, mass media exposure) were significantly associated with adequate PNC utilization.

Only 30.6% of the children received adequate immunization. It was significantly associated with mother characteristics (age, number of under-five children), household characteristics (residence, accessibility to health facility), socio-economic characteristics (education of mothers and fathers, mothers' occupation, wealth index), and child characteristics (age, sex). See detailed in Table 1.

Figure 3 illustrates the SEM diagram for the complex interrelationship between the independent latent constructs and dependent latent constructs. Moreover, it shows the structural path coefficients between latent constructs and factor loadings of each observed variable to the respective latent constructs as shown in the Figure 3.

Measurements of the independent (exogenous) latent constructs in the MNCH model of Myanmar

The largest and the smallest coefficients in the respective exogenous latent constructs are the marital status of mother measurement (0.56) and empowerment measure (-0.95) in the latent construct individual and family characteristics, zone measurement (0.4), and accessibility to health facilities measurement (-0.39) in the latent construct household characteristics, mother's educational status measurement (0.76) and father's occupation measurement (-0.17) in the latent construct socio-economic characteristics, and child-size at birth measurement (0.029) and child's age in completed year measurement (-0.95) in the latent construct child characteristics.

The measurement indicators being negative are age group of the mother (-0.11), child's birth order (-0.056), and empowerment measure (-0.95) in the latent construct individual and family characteristics, whereas residence (-0.33) and access to health facilities (-0.39) in the latent construct household characteristics; mother's occupation (-0.035) and father's occupation (-0.17) in the latent construct socio-economic characteristics; and child's age in the completed year (-0.95) and child's the age group (-0.81) in the latent construct of child characteristics.

All measurement indicators of the latent construct household characteristics and all of the latent construct socio-economic characteristics except mother's occupation are statistically significant at $p < 0.001$.

However, all measurement indicators of the latent construct child characteristics are not statistically significant. And only two measurements, which are the age group of the mother ($p < 0.001$) and empowerment measure ($p = 0.004$), are statistically significant in the latent construct individual and family characteristics (Table 2).

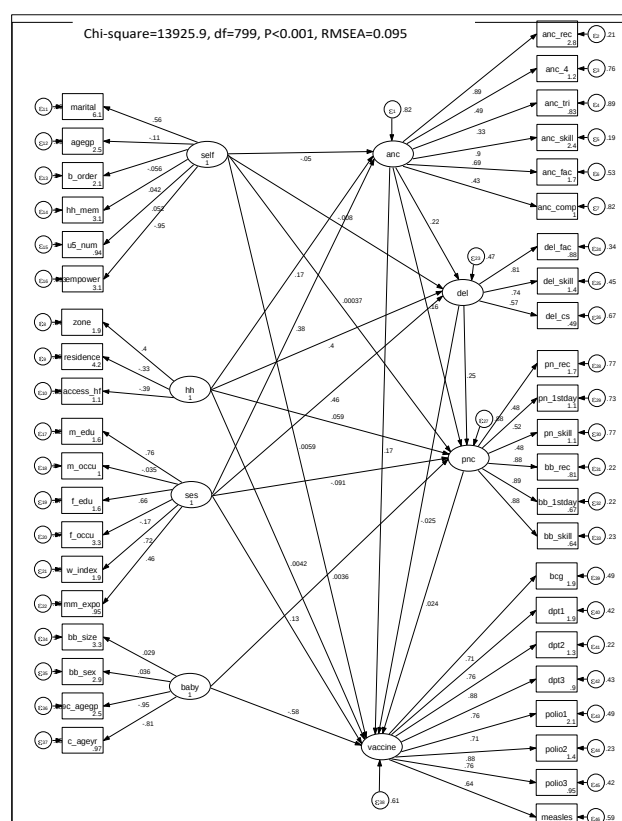


Figure 3: SEM diagram of the relationship between latent independent constructs and latent dependent constructs of the CoC components of MNCH care.

Table 1: Adequate utilization of maternal and child health care among women aged 15-49 who had a live birth in the 2 years preceding the survey in Myanmar.

Characteristics	n=1669, 100%	Adequate antenatal care, (19.7%)	Adequate delivery care, (44.8%)	Adequate postnatal care, (21.8%)	Adequate immunization, (30.6%)
Age group of mothers (years)		P=0.0007	P=0.4902	P=0.7541	P=0.001
≤20	7.8	5.8 [2.7, 11.9]	40.5 [30.5, 51.3]	20.8 [13.5, 30.5]	19.6 [12.8, 28.8]
21-25	23.6	17.3 [13.4, 22.1]	42.4 [35.9, 49.0]	19.9 [15.5, 25.2]	23.8 [19.6, 28.7]
26-30	28.4	20.9 [17.0, 25.4]	43.5 [37.7, 49.4]	21.5 [16.9, 26.3]	30.9 [26.2, 36.1]
31-35	21.9	24.5 [19.6, 30.1]	49.6 [43.3, 55.9]	24.6 [19.8, 30.2]	35.3 [29.3, 41.8]
36-40	13.7	23.6 [17.7, 30.9]	46.7 [39.0, 54.6]	20.9 [15.4, 27.7]	38.1 [30.6, 46.2]
≥40	4.6	14.6 [8.1, 25.0]	43.9 [31.9, 56.6]	25.4 [15.6, 38.6]	37.7 [26.9, 49.9]
Marital status of mother		P=0.3713	P=0.9756	P=0.6935	P=0.4329
Currently married	97.1	19.9 [17.4, 22.6]	44.8 [41.0, 48.6]	21.7 [18.9, 24.8]	30.4 [27.5, 33.5]
Previously married	2.9	14.6 [7.1, 27.8]	45.0 [29.3, 61.9]	24.5 [13.0, 41.3]	36.5 [22.7, 52.9]
Child's birth order		P=0.0004	P<0.001	P=0.0002	P=0.1751
1 st	36.0	24.3 [20.4, 28.6]	63.1 [57.9, 68.0]	28.4 [23.7, 33.6]	29.5 [25.4, 34.1]
2 nd	27.3	21.8 [17.3, 27.0]	44.1 [38.0, 50.3]	18.7 [15.1, 22.9]	34.9 [29.9, 40.3]
3-4 th	24.3	16.4 [12.6, 21.1]	32.3 [26.9, 38.2]	18.9 [15.1, 23.5]	29.4 [24.7, 34.5]
≥5	12.4	8.8 [4.9, 15.1]	17.8 [11.9, 25.9]	14.9 [9.6, 22.4]	26.5 [19.9, 34.5]
Number of household members		P=0.6364	P=0.7752	P=0.4665	P=0.1386
≤5	50.0	20.3 [17.0, 24.0]	44.4 [39.7, 49.2]	20.9 [17.4, 24.9]	28.7 [25.1, 32.7]
>5	50.0	19.2 [16.0, 22.8]	45.2 [40.6, 49.9]	22.6 [19.2, 26.5]	32.5 [28.7, 36.5]
Under 5 children number		P=0.0246	P<0.001	P=0.0007	P=0.0241
<2	59.3	22.0 [19.0, 25.4]	52.5 [48.3, 56.8]	24.7 [21.1, 28.8]	32.9 [29.1, 36.9]
≥2	40.8	16.5 [13.2, 20.4]	33.5 [28.7, 38.7]	17.5 [14.6, 20.9]	27.3 [23.8, 31.0]
Women empowerment		P=0.0016	P=0.0511	P=0.1438	P=0.3229
No	9.6	9.6 [5.71, 15.7]	35.4 [26.3, 45.6]	16.3 [10.5, 24.5]	26.6 [19.5, 35.3]
Yes	90.4	20.8 [18.2, 23.7]	45.8 [41.9, 49.7]	22.4 [19.4, 25.6]	31.0 [27.0, 34.2]
Zone		P=0.0285	P<0.001	P=0.2695	P=0.0589
Hilly	23.4	14.4 [10.1, 20.0]	33.0 [26.6, 40.2]	17.0 [12.0, 23.6]	27.8 [22.6, 33.8]
Coastal	13.6	16.5 [12.8, 21.1]	33.3 [26.2, 41.3]	23.9 [18.0, 31.0]	27.8 [22.4, 33.9]
Delta	32.6	21.2 [17.1, 26.0]	55.0 [47.7, 62.2]	21.7 [16.3, 28.3]	28.2 [23.3, 33.8]
Central plain	30.3	23.8 [18.9, 29.4]	48.0 [41.3, 54.7]	24.6 [20.1, 29.7]	36.5 [30.8, 42.7]
Residence		P<0.001	P<0.001	P=0.0992	P=0.0040
Urban	25.1	30.4 [25.0, 36.4]	75.4 [66.5, 82.6]	26.1 [20.2, 33.1]	38.1 [32.2, 44.3]
Rural	74.9	16.2 [13.6, 19.2]	34.5 [30.5, 38.8]	20.3 [17.3, 23.7]	28.1 [24.8, 31.6]
Accessibility to health facilities		P=0.0001	P<0.001	P=0.0078	P=0.0050
Not difficult	47.9	24.5 [21.3, 28.1]	54.4 [49.8, 59.0]	25.4 [21.7, 29.4]	34.6 [30.7, 38.8]
Difficult	52.1	15.4 [12.5, 18.8]	35.9 [31.3, 40.9]	18.5 [15.0, 22.6]	26.9 [23.2, 31.0]
Mother's educational status		P<0.001	P<0.001	P=0.0002	P=0.0047
No education	15.8	9.3 [5.6, 15.1]	15.5 [10.7, 21.8]	12.1 [7.6, 18.8]	22.1 [16.1, 29.7]
Primary	43.8	16.5 [13.2, 20.5]	35.4 [30.6, 40.6]	22.1 [18.1, 26.6]	31.1 [27.2, 35.2]
Secondary	31.8	22.1 [18.2, 26.6]	61.2 [55.5, 66.5]	22.5 [18.7, 26.8]	31.0 [26.9, 35.4]
Higher	8.6	46.6 [37.1, 56.2]	85.9 [78.2, 91.1]	35.2 [27.4, 43.9]	42.1 [32.8, 52.0]

Continued.

Characteristics	n=1669, 100%	Adequate antenatal care, (19.7%)	Adequate delivery care, (44.8%)	Adequate postnatal care, (21.8%)	Adequate immunization, (30.6%)
Mother's occupation		P=0.0929	P=0.0011	P=0.9958	P=0.0277
Unemployment	43.7	20.7 [17.3, 24.5]	45.1 [39.7, 50.6]	21.8 [18.2, 25.8]	27.6 [24.1, 31.5]
Professional	3.3	26.8 [15.0, 43.3]	50.8 [35.0, 66.4]	19.0 [9.1, 35.3]	30.5 [16.8, 48.8]
Middle-level job	22.3	21.9 [17.0, 27.8]	50.7 [42.7, 58.6]	21.6 [16.5, 27.7]	34.5 [28.9, 40.6]
Agricultural	4.0	6.2 [2.6, 13.9]	25.3 [15.1, 39.2]	21.2 [13.7, 31.3]	20.0 [11.0, 33.4]
Manual	25.5	17.3 [12.9, 22.9]	39.4 [33.5, 45.7]	22.4 [17.3, 28.3]	32.3 [26.4, 38.7]
Others	1.4	22.3 [9.5, 44.0]	82.4 [55.0, 94.7]	23.6 [11.2, 43.1]	61.4 [34.0, 83.1]
Father's educational status		P<0.001	P<0.001	P=0.0005	P=0.0045
No education	18.0	8.1 [5.2, 12.3]	21.4 [16.5, 27.3]	14.2 [9.6, 20.4]	24.5 [18.7, 31.5]
Primary	37.3	15.3 [11.8, 19.5]	36.4 [31.2, 42.0]	18.7 [15.2, 22.9]	27.0 [22.9, 31.7]
Secondary	38.3	25.2 [21.1, 29.9]	56.0 [50.8, 61.0]	26.7 [22.4, 31.5]	35.3 [30.9, 40.0]
Higher	6.5	45.7 [34.9, 57.0]	91.9 [83.6, 96.2]	31.3 [21.0, 43.8]	40.1 [29.3, 51.9]
Father's occupation		P=0.0101	P<0.001	P=0.3438	P=0.5357
Professional	6.8	29.7 [20.4, 41.1]	63.8 [51.6, 74.5]	22.3 [13.9, 33.7]	33.6 [23.3, 45.7]
Middle-level job	26.1	23.2 [18.4, 28.8]	45.1 [37.7, 52.7]	23.8 [18.9, 29.4]	28.9 [24.0, 34.4]
Agricultural	6.0	7.8 [3.8, 15.2]	22.2 [12.0, 33.3]	13.2 [8.5, 20.0]	26.6 [17.8, 37.8]
Manual	58.8	18.4 [15.5, 21.7]	43.5 [39.2, 47.9]	21.5 [18.1, 25.3]	30.9 [27.1, 35.0]
Others	2.3	17.1 [6.1, 39.6]	78.2 [61.1, 89.1]	27.9 [13.3, 49.4]	43.8 [25.0, 64.5]
Wealth index		P<0.001	P<0.001	P=0.0092	P<0.001
Poorest	26.6	12.1 [8.6, 16.7]	21.9 [16.7, 28.2]	16.0 [11.7, 21.5]	23.1 [18.8, 28.0]
Poorer	22.0	13.7 [9.8, 18.7]	33.5 [27.4, 40.2]	19.0 [14.9, 23.9]	23.7 [19.2, 28.8]
Middle	17.2	21.4 [15.9, 28.1]	43.6 [36.6, 50.9]	24.4 [18.2, 31.8]	34.6 [28.4, 41.4]
Richer	18.1	20.6 [15.6, 26.7]	54.6 [47.2, 61.8]	25.1 [19.9, 31.1]	34.0 [27.5, 41.2]
Richest	16.2	38.0 [31.2, 45.2]	87.9 [81.3, 92.4]	28.6 [22.2, 36.0]	44.2 [36.9, 51.8]
Mass media contact		P=0.0002	P<0.001	P<0.001	P=0.7220
No contact at all	43.6	13.9 [10.9, 17.5]	32.2 [27.4, 37.4]	16.3 [13.0, 20.4]	28.8 [24.5, 33.4]
Anyone types of media	40.2	22.9 [19.3, 26.9]	50.1 [44.9, 55.3]	24.3 [20.2, 28.9]	31.9 [27.8, 36.3]
Any two types of media	12.7	24.7 [18.2, 32.7]	61.4 [52.9, 69.3]	24.2 [18.2, 31.5]	31.9 [25.4, 39.2]
All media	3.5	31.5 [20.0, 45.8]	65.4 [49.9, 78.3]	44.2 [32.1, 57.1]	31.9 [20.0, 46.6]
Child's size at birth		P=0.0070	P<0.001	P=0.2235	P=0.5026
Very large	2.3	27.5 [14.3, 46.2]	65.7 [45.6, 81.4]	25.1 [11.5, 46.3]	42.7 [26.2, 61.1]
Larger than average	23.9	19.1 [14.7, 24.4]	42.4 [36.4, 48.6]	25.7 [20.7, 31.5]	30.1 [24.9, 35.9]
Average	57.1	21.7 [18.6, 25.1]	47.1 [42.5, 51.7]	21.3 [17.9, 25.0]	31.1 [27.4, 35.0]
Smaller than the average	11.8	15.4 [10.7, 21.7]	44.7 [35.7, 54.1]	17.0 [11.3, 24.7]	30.1 [23.0, 38.4]
Very small	1.5	18.5 [7.1, 40.4]	45.7 [24.0, 69.2]	29.3 [12.7, 54.2]	19.8 [7.0, 44.6]
Child's sex		P=0.0894	P=0.3686	P=0.1371	P=0.0300
Male	53.9	21.5 [18.4, 25.0]	46.0 [41.4, 50.6]	23.4 [19.8, 27.5]	33.2 [29.4, 37.2]
Female	46.2	17.7 [14.5, 21.3]	43.4 [38.6, 48.3]	19.9 [16.5, 23.7]	27.5 [23.8, 31.6]
Child's age group (Months)		P=0.3091	P=0.9378	P=0.6132	P<0.001
0-8	37.5	22.0 [18.5, 25.9]	44.3 [38.8, 49.9]	20.3 [16.4, 24.9]	0.4 [0.1, 1.2]
9-17	44.1	18.2 [14.8, 22.3]	45.4 [40.6, 50.2]	22.4 [18.6, 26.6]	42.1 [37.4, 47.0]
18-23	18.4	18.8 [14.3, 24.4]	44.3 [37.6, 51.2]	23.3 [18.2, 29.3]	64.5 [57.6, 70.8]

Measurements of the dependent (endogenous) latent constructs in the MNCH model of Myanmar

Factor loading of each observed variable was positive in all endogenous latent constructs and statistically significant at $p < 0.001$. The lowest estimate and highest estimate measure of ANC construct were the received initial ANC in the first-trimester measurement (0.33), and the received ANC by a skilled person (0.9) while those of delivery care construct were delivered with cesarean section (0.57) and delivered at health facility (0.81). Those of PNC construct were mother received a postnatal check by a skilled person (0.48), and newborn received a postnatal check within 1st day (0.89); those of vaccination construct were received measles vaccine (0.64) and received DPT2 and Polio2 (0.88) (Table 2).

Structural path relationships from the exogenous latent constructs to endogenous latent constructs in the MNCH model

The individual and family characteristics negatively influenced ANC (-0.05), which was marginally significant at $p = 0.055$. The household characteristics had positive relationships with the ANC (0.17) and the

delivery care (0.4) at a statistically significant level of $p < 0.001$. All path relationships from the socio-economic characteristics were positive with the ANC (0.38), the delivery care (0.46), and the vaccination (0.13) constructs and were statistically significant at $p < 0.001$ except for the relationship with the postnatal care, which was negative (-0.091) at $p = 0.026$. However, the baby characteristics had a positive relationship with the PNC (0.0036) and a negative association with the vaccination (-0.58) constructs; they were not statistically significant with $p = 0.884$ and $p = 0.207$, respectively (Table 3).

Path relationships along the CoC in the MNCH model

The ANC was positively related with all the consecutive care components, which are the delivery care (0.22), the postnatal care (0.16), and the vaccination (0.17), and all relationships were statistically significant at $p < 0.001$. The relationship from the delivery care to PNC (0.25) was positive and significant at $p < 0.001$. However, path relationships from the delivery care to vaccination (-0.025) and from PNC to vaccination (0.024) were not statistically significant with $p = 0.594$ and $p = 0.280$, respectively (Table 3).

Table 2: Parameters estimates of measurement variables of the CoC for maternal and newborn health care of Myanmar (n=1669).

Figures	Variables	Std. estimate	Std. error	P value
	Individual and family characteristics			
Marital	Marital status of mother	0.56	-	-
Agegp	Age group of mothers (years)	-0.11	0.36	<0.001
B_order	Child's birth order	-0.056	0.38	0.099
hh_mem	Number of household members	0.042	0.13	0.093
u5_num	Under5 children number	0.052	0.15	0.062
empower	Women empowerment	-0.95	1.02	0.004
	Household characteristics			
zone	Zone	0.4	-	-
residence	Residence	-0.33	0.06	<0.001
access_hf	Accessibility to health facilities	-0.39	0.06	<0.001
	Socio-demographic characteristics			
m_edu	Mother's educational status	0.76	-	-
m_occu	Mother's occupation	-0.035	0.09	0.187
f_edu	Father's educational status	0.66	0.04	<0.001
f_occu	Father's occupation	-0.17	0.05	<0.001
w_index	Wealth index	0.72	0.07	<0.001
mm_expo	Mass media contact	0.46	0.03	<0.001
	Child characteristics			
bb_size	Child's size at birth	0.029	-	-
bb_sex	Child's sex	0.036	0.73	0.334
c_ageyr	Child's age in completed year	-0.95	12.36	0.206
c_agegp	Child's age group	-0.81	21.10	0.207
	Antenatal care			
anc_rec	Received ANC	0.89	-	-
anc_4	Received four or more ANC	0.49	0.04	<0.001
anc_tri	Received initial ANC in the first trimester	0.33	0.04	<0.001
anc_skill	Received ANC with skilled person	0.9	0.02	<0.001
anc_fac	Received ANC at the health facility	0.69	0.03	<0.001
anc_comp	Received ANC services	0.43	0.04	<0.001

Continued.

Figures	Variables	Std. estimate	Std. error	P value
Delivery care				
del_fac	Delivered at health facility	0.81	-	-
del_skill	Delivered by skilled person	0.74	0.03	<0.001
del_cs	Delivered with caesarean section	0.57	0.02	<0.001
Postnatal care				
pn_rec	Mother received postnatal check	0.48	-	-
pn_1stday	Mother received postnatal check within 1 st day	0.52	0.07	<0.001
pn_skill	Mother received postnatal check by skilled person	0.48	0.07	<0.001
bb_rec	Newborn received postnatal check	0.88	0.10	<0.001
bb_1stday	Newborn received postnatal check within 1 st day	0.89	0.09	<0.001
bb_skill	Newborn received postnatal check by skilled person	0.88	0.09	<0.001
Vaccination				
bcg	Received BCG	0.71	-	-
dpt1	Received DPT 1	0.76	0.03	<0.001
dpt2	Received DPT 2	0.88	0.04	<0.001
dpt3	Received DPT 3	0.76	0.04	<0.001
polio1	Received Polio1	0.71	0.03	<0.001
polio2	Received Polio2	0.88	0.04	<0.001
polio3	Received Polio3	0.76	0.04	<0.001
measles	Received measles	0.64	0.04	<0.001

Table 3: Parameter estimates of structural equation model of the CoC for maternal and newborn health care of Myanmar (n=1,669).

Paths	Std. estimate	Std. error	P value
self→anc	-0.05	0.08	0.055
hh→anc	0.17	0.03	0.001
ses→anc	0.38	0.14	<0.001
self→del	-0.008	0.10	0.747
hh→del	0.4	0.07	<0.001
ses→del	0.46	0.02	<0.001
anc→del	0.22	0.05	<0.001
self→pnc	0.00037	0.06	0.988
hh→pnc	0.59	0.03	0.355
ses→pnc	-0.091	0.01	0.026
baby→pnc	0.0036	0.20	0.884
anc→pnc	0.16	0.02	<0.001
del→pnc	0.25	0.03	<0.001
self→vaccine	0.0059	0.07	0.783
hh→vaccine	0.0042	0.03	0.935
ses→vaccine	0.13	0.02	<0.001
baby→vaccine	-0.58	5.18	0.207
anc→vaccine	0.17	0.03	<0.001
del→vaccine	-0.025	0.04	0.594
pnc→vaccine	0.024	0.03	0.280

Chi-square=13925.914, df=799, P<0.001, RMSEA=0.095.

DISCUSSION

We conducted this study to determine the factors influencing the continuity of MNCH services from childbearing to child vaccination and to create the MNCH services casual model in Myanmar using 1,669 mothers and children from the MDHS (2015-2016) data. We

found that adequate utilization of ANC was about 20%, 45% in delivery, 22% in PNC, and 31% in the immunization program.

The household and socio-economic constructs positively and significantly influence the utilization of ANC, but individual construct has no effect. All independent latent constructs except individual construct positively and significantly affect the utilization of delivery care. Among four latent independent constructs, only socio-economic construct negatively influences the utilization of PNC. In contrast, only socio-economic construct positively influences the utilization of vaccination. Regarding continuum care components, receiving ANC favors the utilization of subsequent components of delivery, PNC, and vaccination. However, receiving delivery care favors only PNC utilization but not childhood vaccination. In addition, PNC utilization does not affect childhood vaccination.

Our utilization pattern of CoC components pointed out huge inconsistencies between the utilization of each component of MNCH care services. However, it was more or less similar to a study conducted by Owili et al in which ANC (8.8%), delivery (54.8%), PNC (35.2%), and vaccination (31%), respectively.²⁷ In both studies, the switch from delivery to PNC was seemed to be more failure in the care continuum. Mohan et al found that the significant dropout was at the shift from delivery to PNC in the care continuum with the returning rate of less than one among four women who had facility delivery. Utilization of PNC was greater among women who had received well counselling, including family planning during the delivery care and focused on the significance of client engagement not only at the facility but also through community outreach and the family planning

counselling as completion of 'need' factors for returning and receiving PNC.¹³

Our study findings proved that receiving one component of MNCH care favors subsequent utilization of the other components. The ANC utilization had a strong positive relationship with all the cares utilization along the MNCH pathway, which is in line with Owili et al except no connection with PNC utilization. Delivery care utilization favors PNC utilization but not for childhood vaccination.²⁷ In addition, PNC utilization does not affect vaccination. This finding also highlighted the importance of receiving ANC as the entry point of MNCH care.

Moreover, it provides evidence that giving quality ANC will favor the utilization of the CoC. These findings are essential and valuable for policymakers because it points out that the quality and coverage of ANC services should be targeted and promoted to improve the CoC utilization of MNCH services. Similarly, the quality and coverage of delivery care services should be encouraged because of the significant positive relationship of the delivery care service with the PNC utilization, consistent with the finding of Owili et al.²⁷

We found only a weak effect of the exogenous individual construct (self) on ANC, a negative association (-0.05). This finding contradicts the study done by Owili et al which found the negative and significant exogenous effects on antenatal, delivery and immunization program utilization.²⁷ The individuals in the family are responsible and must be aware of the importance and advantages of receiving the MNCH care continuously because Myanmar women have relatively low authority to make decisions, including decisions to take their children and own health care due to the culture.¹⁶

The latent household construct had a significant positive effect on ANC and delivery care. In contrast to this finding, Owili et al found positive effects of this construct on antenatal, postnatal, and immunization program utilization and negative effect on delivery care.²⁷ These discrepancies might be due to utilizing a large data set from 12 sub-Saharan African countries by merging individual countries' data and then producing overall parameter estimates using SEM. Each country's political configuration and different health systems might be the next reason for the inconsistency. The exogenous effects of household characteristics are significant in a country like Myanmar because 56% of the urban people were the wealthiest quintile, matched with only 7% of the rural people. On the other hand, 26% of the rural residents were in the lowest quintile, whereas only 4% of the urban residents were. Moreover, 22% of urban women completed secondary school while only 4% of rural women had completed it.¹⁶

Our study found that the latent socio-economic construct was vital to utilizing the MNCH services continuously because all path relationships were significantly positive

with ANC, delivery care, and vaccination constructs. The association was negative with PNC. In the study of Owili et al the effects of socio-economic characteristics were all positive on the pathway of MNCH care.²⁷ Generally, women with higher socio-economic statuses were more likely to access healthcare because of their financial affordability for health care, accessibility for health information, and capacity to understand and communicate with the health care providers. Moreover, high disparities in the educational level of women and their husbands accompanied by the accessibility of health information and their occupation and financial affordability for health care costs were found in different States and regions of Myanmar. However, our study found a controversial finding, and we need to conduct more studies to explain this issue. Hence, the strategies for improving the maternal and newborn health services and the socio-economic statuses of the women should be identified and formulated to utilize the MNCH services continuously.

Strengths and limitations

It is the first study that assesses the complex relationship between the CoC components and the background characteristics using advanced statistical analytical method (SEM) in Myanmar. We used the nationally representative data set, collected by the stratified two-stage sampling method, and analyzed the data accounting for missing response and cluster survey design. Hence our finding is robust in generalizability. The results will help the policymakers understand the need to accomplish CoC in Myanmar and apply it to planning and integrating MNCH services as the CoC.

There are some limitations. Firstly, the recall bias was a limitation because we measured the MNCH services based on women's recall responses. The DHS minimized the bias by collecting information regarding PNC only from the mothers who had a live birth in the two years preceding the survey. In second, we used the latent construct scores calculated from observed variables in SEM analysis; hence, we could not assess the effect of observed variables on MNCH services.

CONCLUSION

In conclusion, the quality and coverage of ANC is the most crucial factor for the establishment of the care continuum of MNCH services in Myanmar. Therefore, program implementers should integrate MNCH services and improve ANC quality and coverage to accomplish SDG in Myanmar. Regardless of region and residence, the overall socio-economic development of the nation will alleviate the inequity in health access and improve both maternal and child health.

ACKNOWLEDGEMENTS

Author would like to thank to Professor Hla Hla Win, Rector, University of Public Health, Yangon, and all

University of Public Health-Institutional Review Board (UPH-IRB) members for allowing conducting this study. A special thank also goes to the DHS program and ICF International for permitting to use of MDHS (2015-2016) data for the study. Also like to extend my gratitude to all my teachers, my seniors, and juniors from the University of Public Health, Yangon, for their valuable support throughout the process.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of department of medical research in Myanmar and the ICF institutional review board approved the MDHS protocol, respectively. Institutional review board, university of public health, Yangon (UPH-IRB).

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Cite this article as: Myint KS, Mya KS. A causal model of the continuum of care for maternal, newborn, and child health in Myanmar: a structural equation modelling approach. *Int J Community Med Public Health* 2022;9:1992-2002.