# **BMJ Open** Tracking progress towards equitable maternal and child health in Yunnan: a systematic assessment for the Health Programme for Poverty Alleviation in China during 2015–2020

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### ABSTRACT

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**Objectives** To inform the impacts of health programmes which aimed at preventing women and children from being trapped in or returning to poverty because of illness in Yunnan, the main battlefield against poverty in China. **Design** The longitudinal comparative evaluation design. Data collection and analysis National and Yunnan policy documents related to maternal and child health programmes for poverty alleviation during 2015-2020 were analysed. The changes in disparities in maternal and child health system inputs, service coverage, and health outcomes between poor and non-poor areas, as well as out-of-pocket payments between poor and non-poor populations were assessed before and after 2017. **Results** In total 12 policies and 15 programmes related to poverty alleviation for poor women and children in Yunnan were summarised. As a result of health system strengthening in Yunnan, the densities of licensed doctors, nurses, obstetricians, midwives, township health workers and female village doctors had been increased substantially in poor areas, with the annual rates of 14.3%, 22.5%, 21.8%, 23.9%, 14.1% and 7.1% separately. Although disparities existed in some of service coverage between poor and non-poor areas, the health programmes had narrowed the gaps in utilisation of facility birth, caesarean section, prenatal screening and newborn screening across Yunnan (p<0.01). The out-of-pocket payments for inpatient care for serious illnesses among women and children with poverty registration had been considerably decreased to 10.0%. Paralleling the universal coverage, maternal deaths per 100 000 livebirths and child deaths per 1000 livebirths had further declined in both poor and non-poor areas, and the impacts of health programmes on closing the gaps in child survivals across Yunnan were significant (p<0.01).

**Conclusions** Remarkable progress in equitable maternal and child survival has been achieved in Yunnan. The practices in Yunnan have shown the Chinese model in ending poverty by strengthening health system and implementing universal coverage with firm commitment, determined leadership, detailed blueprint and social participation.

# STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study examined the impacts of implementing maternal and child health (MCH) programmes on various outcomes, including health system inputs, service coverage, health outcomes and out-ofpocket payments in Yunnan Province, China, to provide empirical evidence supporting the importance of health programmes in breaking the vicious cycle of poverty and illness among vulnerable populations.
- ⇒ This study employed a difference-in-difference design, which compared outcomes in poor and non-poor areas before and after the intensive implementation of MCH programmes in 2017, and found significant improvements in many indicators of service coverage and health outcome following the interventions.
- ⇒ The effects of MCH programmes were mainly estimated with secondary data at county/township level in this study, which lacked the considerations of some key variables such as maternal literacy and household income and veiled the differences at individual level.

# INTRODUCTION

Maternal and child health (MCH) affects **a** economic growth and social development globally. Reducing maternal and child mortality is continually featured in the United Nations post-2015 Sustainable Development Goals (SDGs) and requires global supports.<sup>1</sup> China has made impressive progress in maternal and child survivals in recent decades. Between 1990 and 2015, maternal mortality rate (MMR) fell from 89 to 22 deaths per 100 000 livebirths and same decrease trend was seen in under-5 mortality rate, falling from 54 to 11 deaths per 1000 livebirths in China.<sup>2 3</sup> However, disparities remained in western China where



the maternal and child survivals were lagging behind in 2015, typically in rural and remote areas of Yunnan Province which is economically deprived and overwhelmingly concentrated by ethnic minorities.<sup>4</sup> Due to poor nutrition, little health knowledge and lack of access to proper sanitation and healthcare services, poor and remote pregnant women and children were vulnerable populations at high risk of severe illness and death, which was the tough challenge facing in China.<sup>4 5</sup> Particularly, both of MMR and under-5 mortality rate were twice as high for ethnic minorities than for their Han counterparts in western China according to a meta-analysis published in 2017.<sup>6</sup> Except for economic and educational disadvantages, traditional beliefs, mountainous topography and poor quality of care were important barriers to seeking MCH care.<sup>7</sup> Maternal and child deaths not only decreased household income but also took a substantial share of national labour productivity loss.<sup>8</sup> Moreover, the treatment cost of disease or long-term complication might trap women and their families in poverty especially when large out-of-pocket expenditures were paid.

To break the vicious cycle of poverty and illness, the China's Government has introduced the Health Programme for Poverty Alleviation Strategy which is an important measure to win the battle against poverty by targeting the poor and remote population precisely and reducing the heath disparities across regions and population groups.<sup>10</sup> In response to this, efforts have been made to ensure that the poor seldom fall ill, but can access and afford healthcare services when falling ill, as they can expect help from national public services, severe illness insurance and government funds which will cover the remaining cost after the relevant reimbursements to protect these people's right to health and prevent them from being trapped in or returning to poverty because of illness.<sup>11 12</sup> Promising to leave no one behind, as the main battlefield against extreme poverty in China, the Yunnan has launched the Thirty Health Actions for Poverty Alleviation in 2017, which includes a series of MCH programmes under Targeted Poverty Alleviation Strategy (hereinafter referred to as MCH-PA programmes) to address the specific challenges when seeking MCH healthcare services, reduce deaths of pregnant women, newborns and children under 5 years old, and avoid catastrophic health expenditures happened to those remote women and children as well as the ethnic minorities in poor rural Yunnan.<sup>13</sup> The MCH-PA programmes which include specific interventions in poor rural areas from strengthening emergency obstetric and newborn care to preventing birth defects, improving child nutrition, supplementing folic acid, breast and cervical cancer screening as well as affordable medical services, also echo the goal of guaranteeing the Healthy China 2030 and Healthy Yunnan 2030 Initiatives and the Strategy of Rural Revitalisation to achieve moderate prosperity in all respects after ending absolute poverty.<sup>13</sup>

We present a systematic assessment in Yunnan to inform the impacts of the MCH-PA programmes which aimed

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health systems experts. As the Yunnan intensively launched MCH-PA programmes in 2017 and aimed at reaching women and children in poor rural areas, we described the variations in MCH system inputs, services coverage and health outcomes between 88 poor rural counties and 41 non-poor rural counties/urban districts before (in 2015) and after (in 2020) MCH-PA programmes. The changes from 2015 to 2020 were calculated for areas with and without MCH-PA programmes. The ratios of poor to non-poor were used to show the differences between areas in 2015 and 2020. In order to assess the impact of MCH-PA programmes more precisely, the township-level data were adopted to estimate the changes in those MCH indicators brought about by MCH-PA programmes in poor areas after 2017, compared with non-poor areas. A total of 912 rural townships from 88 impoverished counties of Yunnan were categorised into the group 'poor areas with MCH-PA programmes'; the remaining 295 rural townships and 109 urban streets from 41 non-poor counties/districts as well as 102 urban streets from impoverished counties were clustered into the group 'non-poor areas without MCH-PA programmes' (506 rural townships/urban streets in total) (see online supplemental appendix figure 2). The effects of MCH-PA programmes on out-of-pocket payments were assessed at individual level, between populations with and without poverty registration.

### **Data sources**

First, we extracted data on MCH outcomes (the number of live births, maternal deaths, neonatal deaths, infant deaths, under-5 deaths, birth defects, low-weight births, underweight children, stunted children, wasted children, overweight children, obese children, anaemic children and anaemic pregnant women) and MCH services (the number of high-risk pregnancies, antenatal visits, prenatal screening, facility deliveries, caesarean sections, postnatal visits, newborn visits and newborn diseases screening) between 2015 and 2020 at both county level and township level, and data on MCH system inputs (the number of obstetricians, midwives and facilities providing delivery services or caesarean sections) between 2017 and 2020 at county level from Yunnan Maternal and Child Health Routine Reporting System. This system reports the annual number of MCH outcomes and service coverage for all 129 rural counties/urban districts including 1418 rural townships/urban streets of Yunnan and data are reliable because rigorous quality control mechanisms including data quality audit process and standardisation of data collection were introduced from 1997 onward. But data on MCH system inputs were added from 2017 onward. Second, data on the number of licensed doctors, licensed nurses, public MCH programme personnel at township level, female village doctors, and hospital beds for all health facilities and the number of beds in the department of gynaecology and obstetrics and in the department of neonatology and paediatrics in 129 rural counties/urban districts across Yunnan between 2015 and 2020 were extracted from Yunnan Health Statistical Yearbooks. Third, we obtained county-level data on total resident population, per capita gross domestic product (GDP), per capita disposable income of rural residents, and

land area between 2015 and 2020 from Yunnan Statistical Yearbooks. The density of MCH health resources per 1000 population or per 1000 livebirths were calculated. Fourth, the individual data on total medical expenditures and outof-pocket payments for the treatment of breast cancer and cervical cancer among women, and the treatment of congenital heart disease and pneumonia among children under 5 years old across Yunnan were extracted from Yunnan Social Medical Insurance Reimbursement Datasets. Medical expenditures of both outpatient care and inpatient care were collected. Finally, policy data related to MCH-PA programmes were provided by Office for Poverty Alleviation People's Government of Yunnan Province, Office for Women Š and Children Health Commission of Yunnan Province, and Yunnan Provincial Maternal and Child Health Care Hospital.

# **Statistical analysis**

copyright We adapted the longitudinal comparative evaluation design and the difference-in-difference (DID) technique to assess the changes in disparities in MCH service coverage and health outcomes between poor and non-poor areas at ß township level before and after MCH-PA programmes.<sup>20</sup> We constructed two dummy variables  $Treat_i$  and  $Time_t$ . If  $\mathbf{Q}$ i is a poor area/person with MCH-PA programmes, the value of  $Treat_i$  is 1 (the treatment group); opposite, the value of *Treat<sub>i</sub>* is 0, if *i* is a non-poor area/person without MCH-PA programmes (the control group). *Time*<sub>t</sub> is a time dummy variable and it is assigned 1 after the implementation of MCH-PA programmes (2018-2020), 0 before e the MCH-PA programmes (2015-2017). Based on the × an DID technique, the theoretical model to estimate the treatment effects comparing the pretreatment and posttreatment differences in the outcome of a treatment and a control group can be expressed as:

Treatment Effect =  $E\left(\Delta Y_i^1 | Treat_i = 1\right) - E\left(\Delta Y_i^0 | Treat_i = 0\right)$  (1)

E is the mathematical expectation in the equation.  $Y_i^{\rm I}$ ⊳ is the observations if i area/person participated MCH-PA programmes.  $Y_i^0$  represents the area/person which did not participate in MCH-PA programmes.  $\Delta Y_i$  shows the differ-, and ence before and after MCH-PA programmes implementation. To estimate the impact of MCH-PA programmes, the similar technologies equation (1) could be designed as follows:

$$Y_{it} = \alpha + \beta Treat_i + \gamma Time_t + \delta Treat_i Time_t + \varepsilon_{it}$$
(2)

Then the coefficient of interaction  $\delta$  in equation (2) measures the effects of MCH-PA programmes:

$$E(\Delta Y_i^{l} - \Delta Y_i^{0}) = [(\alpha + \beta + \gamma + \delta) - (\alpha + \beta)] - [(\alpha + \gamma) - \alpha]$$
$$= (\gamma + \delta) - \gamma = \delta$$
(3)

So we used the following multivariate linear regression model to examine if MCH-PA programmes contributed to the changes in MCH indicators:

> $Y_{it} = \alpha + \beta Treat_i + \gamma Time_t + \delta Treat_i Time_t + \theta X_{it} + \varepsilon_{it}$ (4)

 $Y_{it}$  is any of MCH indicators and data normalisation will be adopted when necessary. *Treat<sub>i</sub>* is poor area dummy indicating poor rural townships where the MCH-PA programmes has implemented. Timet is time dummy indicating years after the implementation of MCH-PA programmes.  $X_{it}$  indicates the confounding variables including per capita GDP, the number of live births or the density of maternal health personnel.  $\alpha$  indicates intercept.  $\varepsilon_{it}$  is residual. The fixed effect of year, which could account for all time-invariant unobserved confounding for two groups, was also included as a covariate. The parallel trends assumption for DID analysis that pretreatment trends in outcomes were same between two groups was verified by regressing each MCH indicator on an interaction term between the binary treatment status and a continuous variable representing years before 2017. The models for continuous outcomes used ordinary least squares, categorical outcomes used logistic, and binary outcomes (such as incidence or mortality) used Poisson. No significant coefficients on the interaction terms were detected, which suggested that the parallel trends assumption was not to be violated and the DID estimators were unbiased. In order to avoid heteroscedasticity and serial correlation of residual, we clustered residual to the county level. All estimates were reported with 95% CIs where relevant. Statistically significant change was defined as change for which the 95% CIs did not overlap zero. All analyses were done with STATA V.15.0.

#### Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

## RESULTS

In total of 69 policy documents related to the national and provincial MCH-PA programmes had been reviewed. Finally, 6 national policies and another 6 policies and 15 MCH-PA programmes of Yunnan were list in figure 1. The Chinese government has maintained a strong focus on MCH through a series of national general and specific Plans of Actions for Women and Children. The guidance on the Implementation of Health Programme for Poverty Alleviation provided a complete legal and policy framework for breaking the vicious cycle of poverty and illness among vulnerable populations, such as poor pregnant women and children, which echoed the Healthy China 2030 initiative. As shown, Yunnan provincial policies and plans of actions were made under the national guidance which specified clear targets and tasks. The ō Yunnan Thirty Health Actions for Poverty Alleviation and Yunnan Actions for Wining Tough Battle against Poverty which were formulated in 2017 and 2019, respectively,



Figure 1 Timeline of Maternal and Child Health Policies and Programmes for Poverty Alleviation during 2015–2020 in Yunnan, China.

emphasised the main objectives to ensure that the MMR and infant mortality rate in Yunnan are, respectively, lower than 20 per 10 000 livebirths and 10 per 1000 livebirths by the end of 2020. Specific strategies in four aspects of financing, infrastructure building/drugs/equipment/ medical suppliers, services provision and health human resources have been designed and realised through the implementations of a series of MCH-PA programmes.

CNY1.3 billion А total amount of (about US\$201.8 million) was transferred from central and provincial governments to the specific MCH-PA programmes in Yunnan from 2017 to 2019. The government's expenses on social basic medical insurance reimbursements for ill women and children were not included in the number mentioned above. Otherwise, another CNY449.1 million (about US\$69.5 million) was especially invested in infrastructure building for MCH system strengthening in poor rural areas in Yunnan. A total of 128 emergency obstetric care centres and 112 emergency newborn care centres have been built until 2020, which nearly covered all the poor counties of Yunnan. For further improving level of and equity in maternal and child survivals in Yunnan, besides the regular free MCH services such as antenatal and postnatal care, the free services including prepregnancy check-up, prenatal screening, newborn diseases screening, child nutrition package, folic acid supplement, breast and cervical cancer screening, and female common disease screening had been provided which had expanded MCH health service coverage to woman and child in poor rural areas. Birth companion and waiting room services in the department of obstetrics had been available for pregnant women at high risk in remote and poor areas since 2013. Meanwhile, counterpart assistance programmes and special training had been conducted. Specialists from Shanghai, Guangzhou and Fujian (the most developed provinces from the Eastern China) and nine tertiary hospitals of Yunnan were assigned to the poor counties or townships and had worked in the department of obstetrics or the department of paediatrics there for 2 years. The capacity-building series training had been given to obstetricians and other medical staff at primary level. Otherwise, a three-tiered financial protection strategy has been made to ensure that medical services would be affordable (out-of-pocket payments at 10%) with basic medical insurance, serious illness insurance, and medical financial assistance schemes among the Households with Poverty Registration. For some extremely poor households, out-of-pocket health expenditure was completely covered by the governmental financial protection strategy.

Poor areas where the MCH-PA programmes have been implemented are home to half of the total population in Yunnan. But population densities in most poor areas were much lower than those in non-poor areas. Between 2015 and 2020, there was a sign that people moved from poor areas to non-poor areas. Although disparities persisted between areas, the per capita GDP and per capita disposable income of rural residents in poor areas had increased at the annual rates of 19.8% and 11.5% respectively, which exceeded those in non-poor areas (14.9% and 11.4%). The decrease trend was seen in the number of live births across Yunnan, but which was not statistically significant (table 1).

As a result of capacity strengthening of MCH system in Yunnan, health workforce and facilities had been growing steadily in poor areas. Not only the numbers of licensed doctors (from 1.1 to 1.9) and nurses (from 1.1 to 2.6) per 1000 population, but also the numbers of obstetricians -(from 10.1 to 15.7) and midwives (from 10.9 to 21.6) per 1000 livebirths had been increased substantially in poor areas, with the annual rates of 14.3%, 22.5%, 21.8% and 23.9% separately. Moreover, the numbers of township  $\boldsymbol{\xi}$ MCH workers and female village doctors in poor areas had been increased largely, who participated in MCH programme implementation and service provision at primary-level (the township level and village level). Disparities existed in most indicators of MCH human resources between poor and non-poor areas, but the gap in the density of obstetricians per 1000 livebirths had become smaller (from 0.83 to 0.76) in 2020. Oppositely, the gaps in densities of township MCH workers and female village uses r doctors per 1000 livebirths had grown larger between areas at the same time period and there were more health staff working for MCH at both township level (p=0.04) and village level (p=0.05) in poor areas, compared with those in non-poor areas. Meanwhile, the percentages of ð township MCH workers with bachelor degree (3.7% vs te 3.6%) and female village doctors with high school degree (2.7% vs 1.5%) had grown faster in poor areas than nonpoor areas. Besides, the densities of hospital beds in the department of gynaecology and obstetrics and the department of neonatology and paediatrics per 1000 livebirths and the densities of facilities providing delivery services and caesarean sections per 1000 livebirths had increased ≥ in poor areas, with the annual rates of 10.2%, 18.5%, 10.9% and 8.6%. (table 1).

Although more than 99% of pregnant women gave birth ŋġ, in health facilities across Yunnan in 2015, the determined efforts to expanding MCH services to every woman and child had resulted in a continuous rise in proportions of births in health facilities in 2020 (from 99.2% to 99.9% in poor areas and from 99.9% to 100.0% in non-poor areas). Both crude (0.49, p<0.01) and adjusted (0.52, p<0.01) DID estimators showed the MCH-PA programmes had effec-Inol tively encouraged facility births in Yunnan. Paralleling the universal coverage in health facility births, the median & caesarean section rates had been increased to 24.5% in § poor areas and 34.8% in non-poor areas, with the annual rates of 1.6% and 1.1%, respectively. The adjusted (1.62, p=0.04) DID estimator showed the MCH-PA programmes had narrowed the gaps in proportions of caesarean section between areas in Yunnan. Proportions of antenatal visits, postnatal visits and newborn visits had showed decrease trend between 2015 and 2020 in poor areas, however, those in non-poor areas followed similar trends. In order to prevent and control birth defects, prenatal screening

	Poor areas with MC	CH-PA programmes		Non-poor areas w	ithout MCH-PA program	mes		
	2015	2020	Annual rate of change	2015	2020	Annual rate of change	Ratio of poor to non-poor, 2015	Ratio of poor to non-poor, 2020
Socioeconomic characteristics								
Population (10 000)	30.8	27.3	-1.0%	33.2	40.5	2.1%	0.93	0.67
	(3.8 to 138.4)	(3.8 to 135)	(-4.3% to 2.4%)	(10.5 to 39.5)	(10.2 to 160.3)	(-2.3% to 6.5%)	(0.16)	(<0.01)
Population per square kilometre	• 103.4	94.4	-1.8%	224.4	202.6	6.3%	0.46	0.47
	(8.8 to 550.7)	(7.5 to 414.5)	(-4.9% to 1.2%)	(68.0 to 2531.2)	(45.6 to 3293.%)	(-6.5% to 19.1%)	(<0.01)	(<0.01)
No of ethnic autonomous regions	25 (28.4%)	25 (28.4%)	I	5 (12.2%)	5 (12.2%)	I	1	I
Per capita GDP (CNY10 000)*	1.8	3.8	19.8%	3.8	6.8	14.9%	0.47	0.56
	(0.7 to 5.6)	(1.6 to 8.7)	(17.3% to 22.3%)	(1.8 to 12.2)	(3.8 to 15.2)	(10.4% to 19.5%)	(<0.01)	(<0.01)
Per capita disposable income	0.8	1.2	11.5%	1.1	1.7	11.4%	0.73	0.71
of rural residents (CNY10 000)*	(0.5 to 1.2)	(0.8 to 1.8)	(10.6% to 12.5%)	(0.6 to 1.6)	(1.3 to 2.4)	(9.8% to 13.1%)	(<0.01)	(<0.01)
No of live births	3180	2703	–2.6%	2878	2864	2.7%	1.10	0.94
	(391 to 22 605)	(418 to 20 056)	(–6.8% to 1.6%)	(1133 to 7918)	(1003 to 13 287)	(-3.2% to 8.7%)	(0.17)	(0.90)
Health system inputs								
No of licensed doctors	289	524	13.5%	612	945	9.2%	0.47	0.55
	(42 to 1 513)	(75 to 2 899)	(8.4% to 18.7%)	(143 to 5 900)	(253 to 8 098)	(-1.0% to 19.3%)	(<0.01)	(<0.01)
Density of licensed doctors per	1.1	1.9	14.3%	1.9%	2.8%	6.7%	0.58	0.68
1000 population	(0.4–3.0)	(0.9 to 6.0)	(11.7% to 16.8%)	(1.0 to 7.1)	(1.3 to 8.4)	(2.1% to 11.3%)	(<0.01)	(<0.01)
No of licensed nurses	322	676	22.4%	653	1242	13.7%	0.49	0.54
	(67 to 2 343)	(81 to 4 580)	(15.5% to 29.4%)	(188 to 7 775)	(362 to 10 834)	(2.3% to 25.2%)	(<0.01)	(<0.01)
Density of licensed nurses per	1.1	2.6	22.5%	2.1	3.7	11.0%	0.52	0.70
1000 population	(0.2 to 4.7)	(1.3 to 8.5)	(19.1% to 25.8%)	(0.5 to 8.9)	(1.5 to 11.3)	(5.5% to 16.6%)	(<0.01)	(<0.01)
No of hospital beds	1017	1574	10.2%	1754	2167	5.2%	0.58	0.73
	(176 to 5286)	(184 to 9073)	(5.1% to 15.4%)	(548 to 12 480)	(647 to 14 374)	(–3.2% to 13.6%)	(<0.01)	(<0.01)
Density of hospital beds per	3.5	5.8	10.7%	5.8	7.2	2.5%	0.60	0.81
1000 population	(1.5 to 9.7)	(3.4 to 17.0)	(8.7% to 12.8%)	(1.4 to 16.0)	(1.2 to 14.8)	(-1.2% to 6.2%)	(<0.01)	(0.01)
No of hospital beds in G&O	112	170	8.3%	168	227	1.8%	0.67	0.75
	(22 to 463)	(25 to 810)	(4.5% to 12.2%)	(34 to 825)	(42 to 1021)	(-4.7% to 8.2%)	(<0.01)	(0.02)
Density of hospital beds in G&C per 1000 livebirths	) 36.5	55.7	10.2%	66.2	67.2	-1.1%	0.55	0.83
	(10.6 to 84.7)	(23.0 to 139.8)	(7.7% to 12.8%)	(4.6 to 297.8)	(12.9 to 184.7)	(-4.6% to 2.5%)	(<0.01)	(0.03)
No of hospital beds in N&P	55	99	14.4%	88	136	7.2%	0.63	0.73
	(0 to 371)	(4 to 580)	(9.1% to 19.7%)	(17 to 1303)	(18 to 1687)	(-4.1% to 18.6%)	(<0.01)	(<0.03)
Density of hospital beds in N&P	17.0	34.1	18.5%	31.5	48.8	3.7%	0.54	0.70
per 1000 livebirths	(0 to 55.7)	(6.6 to 125.8)	(14.8% to 22.3%)	(8.8 to 244.5)	(10.3 to 248.1)	(-2.1% to 9.6%)	(<0.01)	(<0.01)
No of obstetricians†	38	43	7.4%	50	55	3.1%	0.76	0.78
	(5 to 153)	(5 to 187)	(0.2% to 14.5%)	(12 to 257)	(15 to 242)	(-8.0% to 14.2%)	(<0.01)	(<0.01)
Density of obstetricians per	10.1	15.7	21.8%	12.1	20.6	19.3%	0.83	0.76
1000 livebirths†	(1.7 to 24.5)	(3.3 to 53.2)	(15.3% to 28.3%)	(3.4 to 23.6)	(4.7 to 35.2)	(12.1% to 26.5%)	(<0.01)	(0.02)
No of midwives†	42	52	8.3%	69	78	4.2%	0.61	0.67
	(3 to 230)	(2 to 331)	(0.1% to 16.6%)	(10 to 330)	(18 to 372)	(-7.0% to 15.3%)	(<0.01)	(0.02)
								Continued

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	Poor areas with MC	H-PA programmes		Non-poor areas wit	hout MCH-PA program	mes		
	2015	2020	Annual rate of change	2015	2020	Annual rate of change	Ratio of poor to non-poor, 2015	Ratio of poor to non-poor, 2020
Density of midwives per 1000	10.9	21.6	23.9%	15.7	27.7	20.6%	0.69	0.78
livebirths†	(1.2 to 41.9)	(1.0 to 55.0)	(15.8% to 32.0%)	(3.8 to 43.5)	(5.3 to 75.3)	(11.1% to 30.1%)	(0.02)	(0.01)
No of facilities providing delivery services†	13	14	-0.2%	11	10	-2.5%	1.2	1.4
	(2 to 36)	(1 to 36)	(-4.7% to 4.3%)	(1 to 31)	(1 to 28)	(-11.9% to 6.8%)	(0.18)	(0.04)
Density of facilities providing delivery services per 1000 livebirths†	3.0 (0.5 to 12.3)	4.4 (0.7 to 24.5)	10.9% (4.6% to 17.2%)	2.4 (0.3 to 5.4)	3.6 (0.4 to 7.4)	9.7% (0.6% to 18.8%)	1.25 (<0.01)	1.22 (<0.01)
No of facilities providing caesarean sections†	3	3	–3.2%	4	3	-4.4%	0.75	1.00
	(1 to 13)	(1 to 9)	(–9.1% to 2.7%)	(1 to 23)	(1 to 19)	(-15.4% to 6.6%)	(<0.01)	(<0.01)
Density of facilities providing caesarean sections per 1000 livebirths†	0.7 (0.1 to 2.6)	0.9 (0.2 to 2.5)	8.6% (2.7% to 14.5%)	0.8 (0.3 to 2.6)	1.1 (0.2 to 3.5)	7.1% (–1.2% to 15.3%)	0.88 (0.13)	0.82 (0.15)
No of township MCH workers	15	21	12.0%	15	19	6.2%	1.00	1.11
	(4 to 97)	(6 to 153)	(6.7% to 17.3%)	(4 to 47)	(6 to 62)	(1.2% to 11.1%)	(0.98)	(0.17)
Per cent of township MCH workers with bachelor degree and above	13.6% (0% to 44.4%)	30.0% (0% to 90.0%)	3.7% (2.9% to 4.4%)	23.4% (0% to 53.6%)	42.3% (13.6% to 62.5%)	3.6% (2.6% to 4.6%)	0.58 (<0.01)	0.71 (0.01)
Density of township MCH	4.9	8.2	14.1%	5.3	5.9	4.0%	0.92	1.39
workers per 1000 livebirths	(0.6 to 17.6)	(1.7 to 31.1)	(10.8% to 17.4%)	(2.0 to 13.8)	(2.7 to 17.8)	(0.3% to 7.8%)	(0.16)	(0.04)
No of female village doctors	126	162	5.3%	127	142	2.7%	0.99	1.14
	(24 to 565)	(26 to 661)	(2.3% to 8.4%)	(28 to 428)	(28 to 480)	(–1.0% to 10.0%)	(0.67)	(0.17)
Per cent of female village doctors with high school degree and above	82.9% (34.1% to 99.4%)	95.2% (64.3% to 100.0%)	2.7% (2.1% to 3.3%)	94.2% (46.7% to 100.0%)	97.9% (73.4% to 100.0%)	1.5% (0.7% to 2.2%)	0.88 (<0.01)	0.97 (0.03)
Density of female village	34.5	55.6	7.1%	45.7	46.8	2.2%	0.75	1.19
doctors per 1000 livebirths	(15.7 to 92.5)	(25.5 to 132.4)	(5.4% to 8.7%)	(12.3 to 96.2)	(11.0 to 116.2)	(-0.6% to 5.0%)	(0.12)	(0.05)
Data are median (range), rate (95% CI Bold values indicate the statistically s. *CNY6.15=US\$1 in year 2014. Tbata stated in 2017. MCH-PA progra collect and report data, and help MCH GDP, gross domestic product; G&O, d	) or ratio (P> t). ignificant changes. immes indicate the Materi 1 service provision at towr lepartment of gynaecology	nal and Child Health Policies ship level. y and obsterics; MCH, mater	and Programmes for Pover rnal and child health; N&P.	rty Alleviation in Yunnan. To department of neonatology	wnship MCH workers indice and paediatrics.	ate health staff in township	) health centre who man	tge MCH programmes,

for fetal abnormalities and newborn screening for hearing, phenylketonuria (PKU) and congenital hypothyroidism (CH) had been provided free of charge to pregnant women and newborns in poor areas. The annual rates of increase in attendances of fetal abnormalities (12.9% vs 9.6%) and hearing (2.7% vs 1.5%) screening were all faster in poor areas than those in non-poor areas. Ratios of poor to non-poor in newborn screening for PKU and CH were around 1 in both 2015 and 2020 and there were no significant difference between areas (p>0.05). Compared with non-poor areas, the MCH-PA programmes had promoted the attendances of prenatal screening (crude DID estimator 9.08, p<0.05; adjusted DID estimator 13.46, p<0.01) and newborn hearing screening (crude DID estimator 4.68, p<0.01; adjusted DID estimator 4.74, p<0.01) in poor rural areas of Yunnan (table 2).

In addition, the out-of-pocket payments for serious illnesses among women and children with poverty registration had been considerably decreased by the three-tiered financial protection strategy. After MCH-PA programmes had launched, the registered poor women only paid 10.0% of total medical expenses for inpatient care for both cervical cancer and breast cancer, which was much less than those (30.0% and 27.2%) paid by populations without poverty registration (p<0.01). Except for inpatient care, the registered poor women paid for outpatient care much less from their own pockets compared with the non-poor women for treating cervical cancer (50.0% vs 60.0%) and breast cancer (50.0% vs 62.7%) (p<0.01). Same trend had been seen among children under 5 years old and the households with registered registration paid less for both inpatient and outpatient care for children with congenital heart disease (10.0% vs 43.1%, 65.0% vs)75.0%) or pneumonia (10.0% vs 46.0%, 50.0% vs 60.0%), compared with their counterparts (p<0.01). Moreover, for those without poverty registration, the out-of-pocket payments for inpatient care for cervical cancer (from 35.0% to 30.0%), breast cancer (from 30.0% to 27.2%) and pneumonia (from 48.0% to 46.0%) had declined after the MCH-PA programmes had launched, whereas the out-of-pocket payments for outpatient care had only declined in the treatment of pneumonia (from 77.2% to 60.0%) among children under 5 years old (p<0.01) (table 3).

As a result, maternal deaths per 100000 livebirths and child deaths (including neonatal, infant and under-5 deaths) per 1000 livebirths had declined substantially between 2015 and 2020 in both poor and non-poor areas. The median MMR per 100000 livebirths declined from 17.8 to no death in poor areas and from 16.3 to no death in non-poor areas. Difference in MMR between areas had not been found, however, the impact of MCH-PA programmes on maternal survivals was not significant and the gap between poor and non-poor areas had not gone closer with the estimated change trend of MMR from 2015 to 2020 (table 2, figure 2A).

The median neonatal mortality rate (NMR) varied 1.59 times (p<0.01) between poor and non-poor areas

of Yunnan in 2015 and 1.43 times (p<0.01) in 2020, whereas the median IMR varied 1.50 times (p<0.01) and 1.54 times (p<0.01), and the median U5MR varied 1.53 times (p<0.01) and 1.37 times (p<0.01), respectively. All the NMR (-11.1% vs -10.8%), IMR (-9.4% vs -9.3%) and U5MR (-7.8% vs -7.7%) per 1000 livebirths had decreased faster in poor areas than those in non-poor areas. Although disparities remained between areas, the impacts of MCH-PA programmes on closing the gaps in child survivals across Yunnan were significant (p<0.01) (table 2) which were showed obviously with the estimated change trend of NMR, IMR and U5MR from 2015 to 2020 (figure 2).

Between 2015 and 2020, the prevalence rate of child **Z** underweight had significantly decreased in both poor areas (from 1.8% to 1.3%) and non-poor areas (from 2.0%to 1.5%), however, the prevalence rate of child stunted had only decreased in non-poor areas (from 1.9% to 1.4%). Oppositely, the percentages of children who were either overweight (from 0.4% to 0.5%) or obese (from 0.2% to 0.3%) had increased in poor areas at an annual rate of 0.1%, whereas there were no significant changes in non-poor areas. But children in non-poor areas were use more likely to be stunted, overweight or obese, compared with their counterparts in poor areas (p<0.01). Moreover, the proportions of anaemic children had decreased from 25.3% to 18.2% (annual rate of decline -1.2%) in poor areas of Yunnan during the same time period (table 2).

# DISCUSSIONS

Ending poverty in all its forms is the first goal of UN Ending poverty in all its forms is the first goal of UN as SDGs.<sup>1</sup> Nearly 20 million people in China were victims of a poverty or had returned to poverty because of illness in **B** 2015, which accounted for 44.1% of the total number of poor population.<sup>11</sup> The poverty headcount ratio in rural China was 5.7% in 2015,<sup>21</sup> whereas the prevalence rates of  $\geq$ poverty among women of childbearing age (15–59 years) and children under 5 years in rural Yunnan in the same ng, year were 7.83% and 5.92%. The poverty headcount ratios among women and child being higher than the national average level indicated a greater impact of poverty on women and children in Yunnan. Our systematic assessment in Yunnan provides evidence of the positive effects of launching health programmes on preventing households from being trapped in or returning to poverty by decreasing maternal and child mortality and morbidity, as well as avoiding the catastrophic medical expenses because of illness, which is an important feature of 3 China's poverty alleviation efforts and an useful measure to win the battle against poverty for whole China.

Remarkable progress in equitable maternal and child survival has been achieved in Yunnan, which is not only an outcome, but an essential component of poverty reduction. The MMR fell to 12.42 deaths per 100000 livebirths and under-5 mortality rate fell to 6.89 deaths per 1000 livebirths in 2020 in Yunnan, which had been below the national average for three consecutive years.<sup>22</sup>

	Poor areas with MC	H-PA programmes		Non-poor areas with	iout MCH-PA program	imes		
	2015	2020	Annual rate of change	2015	2020	Annual rate of change	Crude DID estimator (P> T )	Adjusted DID estimator (P> T )
MCH service coverage								
Births in health facility	99.2%	99.9%	0.2%	99.9%	100.0%	<0.1%	0.49	0.52
	(91.6% to 100.0%)	(94.0% to 100.0%)	(0.1% to 0.3%)	(98.3% to 100.0%)	(99.6% to 100.0%)	(0.0% to 0.1%)	(<0.01)	(<0.01)
Caesarean sections	16.6%	24.5%	1.6%	29.4%	34.8%	1.1%	1.37	1.62
	(3.7% to 35.7%)	(7.1% to 46.8%)	(1.2% to 2.0%)	(13.4% to 42.0%)	(19.1% to 45.6%)	(0.6% to 1.6%)	(0.29)	(0.04)
Five and more antenatal visits	96.2%	93.5%	–1.9%	98.3%	93.7%	–2.1%	0.69	0.83
	(50.1% to 100.0%)	(80.0% to 95.9%)	(–2.6% to –1.3%)	(83.5% to 99.3%)	(92.4% to 98.4%)	(–3.0% to –1.3%)	(0.73)	(0.53)
First trimester antenatal visits	94.4%	93.6%	-0.6%	96.5%	94.5%	-0.7%	0.52	0.80
	(43.5% to 99.9%)	(80.1% to 97.0%)	(-1.2% to 0.0%)	(75.6% to 99.3%)	(92.4% to 98.9%)	(-1.5% to 0.1%)	(0.78)	(0.46)
High-risk pregnancy management	100.0%	100.0%	<0.1%	100.0%	100.0%	<0.1%	0.02	0.05
	(97.2% to 100.0%)	(98.7% to 100.0%)	(-0.0% to 0.0%)	(99.8% to 100.0%)	(99.9% to 100.0%)	(-0.0% to 0.0%)	(0.76)	(0.39)
Any postnatal visits	98.3%	97.7	-0.4%	98.9%	98.4	–0.2%	-0.61	-0.67
	(83.5% to 100.0%)	(84.4% to 99.9%)	(-0.7% to 0.0%)	(83.9% to 99.5%)	(94.9% to 99.8%)	(–0.6% to 0.1%)	(0.45)	(0.32)
Prenatal screening for fetal abnormalities	0.0%	68.1%	12.9%	41.1%	90.2%	9.6%	9.08	13.46
	(0.0% to 46.7%)	(6.3% to 99.5%)	(11.9% to 13.9%)	(0.0% to 97.7%)	(64.5% to 99.9%)	(7.3% to 11.8%)	(<0.05)	(<0.01)
Newborn visits	98.6%	97.9	-0.4%	99.5%	99.6%	–0.2%	0.42	0.23
	(80.1% to 99.9%)	(83.7% to 100.0%)	(-0.6% to 0.0%)	(83.9% to 100.0%)	(95.3% to 100.0%)	(–0.6% to 0.3%)	(0.63)	(0.70)
Newborn hearing screening	86.7%	98.7%	2.7%	95.6%	98.9%	1.5%	4.68	4.74
	(27.3% to 99.7%)	(86.6% to 100.0%)	(2.3% to 3.1%)	(57.4% to 99.8%)	(84.4% to 99.9%)	(1.0% to 2.1%)	(<0.01)	(<0.01)
Newborn screening for PKU and CH†	91.1%	98.9%	2.2%	89.4%	98.9%	2.4%	-0.75	-1.25
	(58.0% to 100.0%)	(75.8% to 100.0%)	(1.7% to 2.7%)	(67.2% to 100.0%)	(84.5% to 100.0%)	(1.6% to 3.3%)	(0.66)	(0.33)
MCH outcomes								
Maternal deaths per 100 000	17.8	0.0	–10.1%	16.3	0.0	–12.4%	0.14	-1.15
livebirths	(0.0 to 127.7)	(0.0 to 193.8)	(–17.4% to –2.7%)	(0.0 to 173.3)	(0.0 to 125.2)	(–20.3% to –4.5%)	(0.98)	(0.80)
Neonatal deaths per 1000 livebirths	s 6.2	3.0	–11.1%	3.9	2.1	–10.8%	-0.81	-1.21
	(2.6 to 17.6)	(0.0 to 7.9)	(–12.8% to –9.3%)	(0.8 to 10.5)	(0.6 to 5.7)	(–13.5% to –8.2%)	(0.02)	(<0.01)
Infant deaths per 1000 livebirths	9.3	5.4	-9.4%	6.2	3.5	–9.3%	-1.08	-1.70
	(4.9 to 25.1)	(0.5 to 14.2%)	(-11.0% to -7.9%)	(1.7 to 11.5)	(0.8 to 8.9)	(–11.5% to –7.2%)	(0.02)	(<0.01)
Under-5 deaths per 1000 livebirths	11.9	7.4	–7.8%	7.8	5.4	-7.7%	-0.98	-1.82
	(7.7 to 31.6)	(2.5 to 20.8)	(–9.4% to –6.3%)	(2.1 to 14.5)	(1.7 to 11.3)	(-10.0% to -5.4%)	(<0.10)	(<0.01)
Born at low birth weight	3.9%	3.9%	0.1%	3.9%	4.0%	0.1%	-0.26	-0.30
	(1.7% to 7.3%)	(2.2% to 6.6%)	(-0.0% to 0.1%)	(2.2% to 5.7%)	(1.3% to 7.2%)	(0.1% to 0.2%)	(0.12)	(0.04)
Underweight children	1.8%	1.3%	-0.1%	2.0%	1.5%	–0.1%	-0.08	-0.10
	(0.5% to 9.0%)	(0.2% to 5.2%)	(-0.2% to -0.1%)	(0.6% to 4.8%)	(0.4% to 3.1%)	(–0.2% to –0.0%)	(0.71)	(0.50)
Stunted children	0.9%	0.9%	<-0.0%	1.9%	1.4%	–0.1%	0.38	0.27
	(0.1% to 6.4%)	(0.0% to 4.7%)	(-0.1% to 0.0%)	(0.3% to 7.7%)	(0.3% to 4.3%)	(–0.2% to –0.0%)	(0.06)	(0.11)
Wasted children‡	0.7% (0.0% to 3.1%)	0.5% (0.0% to 3.0%)	<-0.1% (-0.1% to 0.1%)	0.8% (0.0% to 3.4%)	0.8% (0.1% to 2.2%)	<-0.1% (-0.2% to 0.1%)	I	1
Overweight children	0.4%	0.5%	0.1%	0.9%	1.4%	–0.1%	0.32	0.74
	(0.0% to 5.4%)	(0.0% to 5.1%)	(0.0% to 0.1%)	(0.1% to 19.9%)	(0.0% to 12.8%)	(–0.4% to 0.2%)	(0.46)	(0.02)
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	Door areas with MC	CH-PA programmes		Non-noor areas wi	thout MCH-PA prodra	semm		
				INUI-DUUI AIEAS WI				
	2015	2020	Annual rate of change	2015	2020	Annual rate of change	Crude DID estimator (P> T )	Adjusted DID estimator (P> T )*
Obese children	0.2% (0.0% to 2.1%)	0.3% (0.0% to 6.0%)	0.1% (0.0% to 0.1%)	0.5% (0.0% to 4.4%)	0.7% (0.1% to 2.9%)	<-0.1% (-0.1% to 0.0%)	0.22 (0.08)	0.27 (0.01)
Anaemic children§	25.3% (1.5% to 30.5%)	18.0% (1.3% to 21.3%)	–1.2% (–2.6% to –0.3%)	1	I	1	1	1
Data are median (range) or rate (95% Bold values indicate the statistically s *DID estimators were adjusted by yea Tbata stated in 2016. #Data stated in 2018. #Haemoglobin values adjusted by atti CH, congenital hypothyrioidism; DID, o	CI). ignificant changes. r, per capita GDP, the number tude. lifference-in-difference; GDP,	of live births or the density ogross domestic product; MC	of maternal health personne 2H, maternal and child heal	el. th; MCH-PA, Maternal an	d Child Health Policies and	d Programmes for Poverty.	Alleviation: PKU, phenyll	etonuria.

While the inequality in maternal mortality between poor areas and non-poor areas has disappeared, the gaps in child mortalities (including neonatal, infant and under-5 child) across Yunnan have also been closing. The proportions of maternal deaths due to obstetric haemorrhage, neonatal and infant deaths due to preterm birth and low birth weight, and the preventable maternal deaths had decreased in poor areas between 2015 and 2020. China's efforts to improve maternal and child survival have been extraordinary and coherent. The progress presented by this research is not only past-depended but also boosted by China's Targeted Poverty Alleviation Strategy. Yunnan, as one of the most underdeveloped provinces in China, owned the most impoverished counties in 2014.<sup>16</sup> The mountainous environment, cultural diversity and weak 8 service delivery at primary level of Yunnan made people living in poor areas face a range of interrelated cultural, financial, geographical and institutional barriers in seeking formal healthcare.<sup>7</sup> To defeat the vicious cycle of poverty and illness, especially among vulnerable populations like poor women and children, a series of MCH-PA programmes have been introduced in Yunnan to strengthen MCH system in poor rural areas by building r uses infrastructures, improving human resources, expanding service coverage and providing financial protection.<sup>13</sup>

The huge investments in the constructions of emergency obstetric care centre and emergency newborn care centre with the referral pathway across provincial, ç prefecture and county levels in Yunnan have guaranteed the timely rescue service providing to the pregnant and newborn in risk. To identify the high-risk pregnancy as early as possible, counterpart assistance programmes and special training had been conducted at primary level for **a** MCH human resource capacity building in rural Yunnan.<sup>23</sup> Hence, the densities of licensed doctors, nurses, obstetricians and midwives, as well as township MCH workers and female village doctors had been increased substantially in poor areas between 2015 and 2020. The gaps had been narrowed not only in the quantity of health staff but also in the quality of them. There are now more township MCH workers with bachelor degree and female village doctors with high school degree in poor areas than those in non-poor areas. Township MCH workers and female village doctors play very important roles in MCH system who mainly participate in MCH programme implementation at primary level and special service provision such as birth companion and waiting room services for pregnant women at high risk in remote and poor areas.<sup>24</sup> With the increase of both quantity and quality of MCH human resources, our DID statistical models showed the positive effect of MCH-PA programmes on expanding MCH service coverage in poor areas. Except for the proportions of facility birth, caesarean section, antenatal visit and postnatal visit which had achieved the national average,<sup>22</sup> the proportions of prenatal screening and newborn diseases screening had increased in both poor and non-poor areas to prevent birth defects, but much faster in poor areas. Otherwise, MCH-PA programme

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TME per time (CN   Inpatient care for cervical 7712.4   cancer of women (626.4 to 69233.2)   Cutpatient care for (198.1   Cervical cancer of women (645.9 to 35273.2)   Inpatient care for breast (645.9 to 35273.2)   Outpatient care for breast (11.4   Cancer of women (3.4 to 3242.9)   Inpatient care for breast 11451.4		(2018–2020)		programmes (2018–2020)		Ratio of oop% for hefore and	Ratio of oop% for populations
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Outpatient care for cervical cancer of women198.1 (15.8 to 12.471.8)Inpatient care for breast cancer of women6418.0 (645.9 to 35.273.2)Outpatient care for breast cancer of women11.4 (3.4 to 3.242.9)Inpatient care for hpatient care for11451.4	35.0% (10.0% to 83.1%)	6580.9 (844.0 to 51 800.2)	30.0% (4.1%% to 74.2%)	5870.0 (514.5 to 51676.5)	10.0% (0.0% to 51.9%)	0.86 (<0.01)	0.33 (<0.01)
Inpatient care for breast6418.0cancer of women(645.9 to 35.273.2)Outpatient care for breast111.4cancer of women(3.4 to 3.242.9)Inpatient care for11451.4	30.0% (15.0% to 98.6%)	65.0 (3.8 to 18305.7)	60.0% (12.0% to 100.0%)	56.4 (5.0 to 1465.9)	50.0% (13.2% to 100.0%)	2.00 (<0.01)	0.83 (<0.01)
Outpatient care for breast 111.4 cancer of women (3.4 to 3 242.9) Inpatient care for 11451.4	30.0% (10.0% to 73.9%)	5472.6 (954.2 to 33 121.9)	27.2% (3.6% to 73.9%)	5448.8 (617.6 to 36845.7)	10.0% (0.0% to 47.2%)	0.91 (<0.01)	0.37 (<0.01)
Inpatient care for 11451.4	45.0% (18.4% to 100.0%)	83.1 (3.4 to 10023.0)	62.7% (9.0% to 100.0%)	51.5 (5.0 to 2390.5)	50.0% (16.6% to 100.0%)	1.39 (<0.01)	0.80 (<0.01)
Congenital heart disease (969.5 to 152 605.8 of children under-5	47.1% (10.0% to 81.3%)	21352.3 (1169.1 to 219 126.7)	43.1% (20.8% to 79.8%)	10354.5 (217.2 to 97 009.6)	10.0% (9.5% to 46.7%)	0.92 (0.12)	0.23 (<0.01)
Outpatient care for 230.0 Congenital heart disease (9.0 to 4 384.0) of children under-5	75.1% (22.2% to 94.0%)	223.0 (0.7 to 18776.7)	75.0% (27.3% to 93.9%)	172.0 (14.7 to 285.0)	65.0% (35.6% to 100.0%)	1.00 (0.76)	0.87 (<0.01)
Inpatient care for 2358.1 Pneumonia of children (573.2 to 9147.2) under-5	48.0% (20.2% to 81.7%)	2240.1 (410.5 to 12073.3)	46.0% (20.4% to 77.8%)	1933.7 (0.0 to 8627.5)	10.0% (0.0% to 35.3%)	0.96 (<0.01)	0.22 (<0.01)
Outpatient care for 63.9 Pneumonia of children (0.3 to 223.0) under-5	77.2% (28.6% to 99.4%)	60.4 (8.8 to 215.2)	60.0% (30.8% to 100.0%)	50.1 (6.3 to 196.3)	50.0% (15.1% to 100.0%)	0.78 (<0.01)	0.83 (<0.01)
Data are median (range) or ratio (P>)t). Bold values indicate the statistically significant chang MCH-PA programmes indicate the Matemal and Chil CNY, Chinese Yuan; OOP, out-of-pocket payments; P	es. Health Policies and Programmes R, poverty registration, TME, total	s for Poverty Alleviation in Yun medical expenses.	nan.				

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Figure 2 Estimated change trend of MMR (A), NMR (B), IMR (C) and U5MR (D) among all areas and areas with and without MCH-PA programmes from 2015 to 2020 in Yunnan, China. IMR, infant mortalityrate; MCH-PA, Maternal and Child Health Policies and Programmes for Poverty Alleviation; MMR, maternal mortality rate; NMR, neonatal mortality rate; U5MR, under-5 mortality rate.

such as nutrition improvement for poor children, folic acid supplementation for poor pregnant women, and cervical and breast cancer screening for rural women at childbearing age had been delivered and enlarged in poor areas to prevent diseases or identify diseases at an early stage, thus improving health among targeted populations.<sup>25 26</sup> The percentages of underweight children and anaemic children in poor areas of Yunnan had been decreased significantly between 2015 and 2020. Accessibility to essential health services is also improved by providing health insurance and financial assistance schemes.<sup>27</sup> With supports from MCH-PA programmes, all registered poor women and children are covered by a three-tiered financial protection strategy. The out-ofpocket payments for inpatient care for poor women and children with cancer or heart disease had been considerably decreased to 10% of total medical expenses which may greatly help them access high-quality treatments and avoid catastrophic medical expenses.<sup>28</sup>

Despite impressive progress in maternal and child survival has been made in Yunnan, the current research points out that insufficient MCH system inputs, unmet needs and poor health outcomes still remain in small parts of poor areas in Yunnan. To maintain what have been achieved, the current MCH-PA programmes should be continued and enhanced for a sustainable improvement in accessibility to and affordability of high-quality MCH services, which may be one of the main focus areas of rural revitalisation after Chines government announced that all 98.99 million impoverished rural residents have been lifted from absolute poverty according to the current poverty line by 25 February 2021.<sup>29</sup> In this study, we found while the proportion of underweight children had decreased, the proportions of overweight (0.5%) and obese (0.3%) children had increased in poor areas in Yunnan. Although there was not a change, the proportions of overweight (1.4%) and obese (0.7%) children in non-poor areas were much higher than those in

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poverty alleviation in China. The practices in Yunnan have showed the Chinese model in ending poverty with health programmes, which may be summarised as firm commitment and determined leadership from the government at all levels, people-centred and problem-oriented health system strengthening, detailed and long-term health strategy blueprint, and social mobilisation and participation. China has its own poverty alleviation policies, derived from theory to practice and based on its own national conditions, which can provide new perspectives and useful references for other countries and regions in their battle against poverty.<sup>33</sup>

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Patient consent for publication Not applicable.

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