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Original Research Article

Monitoring of health and nutrition sustainable development goals and indicators: a case of estimation of denominators in thirteen 100 million+ countries for the mid-year of 2017

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ABSTRACT

Background: The success of any program is measured by continuous monitoring through service statistics for a periodic oversight and through evaluation surveys to measure the relevance, effectiveness, efficiency and impact of activities in the light of specified objectives. Service statistics need a lot of indicators to be tracked on a regular basis. The service statistics provide us with numerators. To understand the numerators more meaningfully, we need to standardize them by using specific denominators. So, denominators have to be estimated, which can enable computation of indicators for monitoring purposes. Census and large scale sample surveys provide proportions to calculate denominators for program monitoring purposes.
Methods: This paper uses demographic techniques to estimate denominators for the thirteen 100 million plus countries as of UN projections, 2017 of Philippines, Ethiopia, Japan, Mexico, Russian Federation, Bangladesh, Nigeria, Pakistan, Brazil, Indonesia, United States of America, India and China.
Results: The denominators have been estimated for number of live births, number of annual pregnancies, the first 1,000 days, children and women of reproductive age (15 to 49 years), pregnant, lactating, non-pregnant and non-lactating women, elderly in the age group of 60+ years.
Conclusions: The estimations of denominators at the sub-national levels becomes quite challenging due to the scarce availability of data to be used as proportions for different population groups. But, once, the methodology is improved with appropriate data, it could serve as a boon for annual program monitoring process at multiple data time points between two national surveys and between two consecutive censuses.

Keywords: Demographic techniques, Estimation of denominators, Program planning and monitoring

INTRODUCTION

Program monitoring and evaluations are the means to understand a program. Program evaluation is periodic, while program monitoring is continuous. For program monitoring, there is a need to have data on the population group, which is the target audience for receiving the program. This is usually available through population censuses, which with quinquennial or decadal. But, during the inter-censal period, there is a need to obtain data on denominators for monitoring the program to enable effective course corrections to achieve the program objective, outputs and outcomes. This is an attempt to devise a methodology to arrive at these denominators for program monitoring.

Table 1: Demographic profile of thirteen, 100 million plus countries in the world, 2017.

Continent	Region	World Bank Classification of countries, June 2017	Countries/ World	Total population in millions	Average annual rate of population change, percent	Proportion of total world population (%)	TFR, per woman	Life expectancy at birth (years), 2017		Adolescent birth rate per 1,000 girls aged 15-19 years
				2017	2010-2017	2017	2017	Male	Female	2006-2015
Asia	South Asia	Lower middle income	Bangladesh	164.7	1.1	2.2	2.1	71	75	113
South America	Latin America & Caribbean	Upper middle income	Brazil	209.3	0.9	2.8	1.7	72	79	65
Asia	East Asia & Pacific	Upper middle income	China	1,409.5	0.5	18.7	1.6	75	78	6
Africa	Sub-Saharan Africa	Low income	Ethiopia	105.0	2.6	1.4	4.1	64	68	71
Asia	South Asia	Lower middle income	India	1,339.2	1.2	17.7	2.3	67	70	28
Asia	East Asia & Pacific	Lower middle income	Indonesia	264.0	1.2	3.5	2.3	67	72	48
Asia	East Asia & Pacific	High Income	Japan	127.5	-0.1	1.7	1.5	81	87	4
Central America	Latin America & Caribbean	Upper middle income	Mexico	129.2	1.4	1.7	2.2	75	80	83
Africa	Sub-Saharan Africa	Lower middle income	Nigeria	190.9	2.6	2.5	5.5	53	55	122
Asia	South Asia	Lower middle income	Pakistan	197.0	2.1	2.6	3.4	66	68	44
Asia	East Asia & Pacific	Lower middle income	Philippines	104.9	1.6	1.4	2.9	66	73	57
Europe	Europe & Central Asia	Upper middle income	Russian Federation	144.0	0.1	1.9	1.8	66	77	27
Northern America	North America	High income	United States of America	324.5	0.7	4.3	1.9	77	82	27
13, 100 million plus countries	-	-	-	4,710		-	-	-	-	-
World	-	-	-	7,550	1.2	100.0	2.5	70	74	44

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248; Region and economy classification: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-group.s

The availability of denominators on a regular basis is a necessity for programmatic purposes. This is usually available through population censuses, which is quinquennial or decadal. Censuses are quite expensive and are conducted non-annually at an interval of five or ten years. So, there is a need to project population at national as well as sub-national levels and estimate age specific denominators during the inter-censal period. Though there have been methods to estimate denominators at national and sub-national levels. There is still an unmet need to have a standardized method of estimation of denominators.

This paper uses demographic techniques to estimate denominators for the thirteen 100 million plus countries as of UN projections, 2017 of Philippines, Ethiopia, Japan, Mexico, Russian Federation, Bangladesh, Nigeria, Pakistan, Brazil, Indonesia, United States of America, India and China. Seven of these countries hail from Asia, two from Africa, one each from north, south and central America and Europe. Among these 13 countries, there are 2 billion plus and 11, 100 million plus countries, which constitute about 62% of the total population of the world, with about 4.71 billion population. They constitute 55% of the total under five population in the world. 58.1% and 58.6% of the adolescents and youth respectively reside here. 54.6% of the births and pregnancies are from these 13 countries. 57.4% and 60.6% of the adolescent girls 10 to 19 years of age and women of reproductive age of 15 to 49 years reside in these countries respectively.[1] These countries belong to different regions and different economies.

Study objectives

In order to devise a methodology to estimate denominators for program monitoring, population data from thirteen 100 million plus countries has been used as an example with data validation from the smallest health catchment areas from the two countries of Indonesia and Philippines to use them as inputs for program planning and monitoring.

METHODS

This paper uses demographic techniques to estimate denominators for the thirteen 100 million plus countries as of UN projections, 2017 of Philippines, Ethiopia, Japan, Mexico, Russian Federation, Bangladesh, Nigeria, Pakistan, Brazil, Indonesia, United States of America, India and China. Seven of these countries hail from Asia, two from Africa, one each from north, south and central America and Europe. The denominators have been estimated for monitoring 2 goals out of the 17 Sustainable Development Goals (SDGs) and 169 targets which have been announced to demonstrate the scale and ambition of this new universal Agenda since the end year of Millennium Development Goals (MDGs) in 2015. These seek to build on the MDGs and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental.

The age wise denominators have been computed under certain assumptions. The life cycle approach can be best understood by example of childhood malnutrition. The first 1,000 days ranging from conception to the end of the second year of life is crucial for any intervention to ensure adequate nutrition and development, which will bring benefits throughout life. Focusing on this period increases the child's chance of having a healthy and productive life in the future, and helps to break the inter-generational cycle of poverty. It is also known that maternal nutrition is an important determinant of child malnutrition. Many children are born malnourished because their mothers are malnourished, highlighting the significance of nutrition for women of childbearing age. The nutritional status of the women is a result of interactions among many risk factors like access to food, disempowerment, customs and traditions, nutritional demands of frequent pregnancies and lactation, and access to health services. Therefore, to tackle the issue of malnutrition, we need to have a life cycle approach – care during intrauterine life, the vulnerable first few years of life and the most neglected adolescent period. So, in this paper, we have tried to estimate the denominators for all these groups for the purpose of monitoring, which could be used at sub-national levels also.

The time periods considered here are based on the following references and assumptions: The calculation of month has been considered here as 30 days based on the sidereal year (the orbital period of the earth around the sun, taking the stars as a reference frame) of 365.25 days or 365 days and 6 hours, which comes to 365.25 days /12 months = 30.4375 days rounded off to 30 days in a month. The neonatal period is considered from birth through 27 days, 23 hours, 59 minutes, while the Post Neonatal period is considered from the end of 28th day through 364 days and the infant period is considered as 364 days, 23 hours, 59 minutes from the moment of birth. The World Health Organization (WHO defines adolescents as those people between 10 and 19 years of age. Youth is defined by the United Nations as 15 to 24 years and young people as 10 to 24 years, a term used by WHO and others to combine adolescents and youth. The World Health Organization (WHO) defines adolescents as those people between 10 and 19 years of age. The great majority of adolescents are, therefore, included in the age-based definition of "child", adopted by the Convention on the Rights of the Child as a person under the age of 18 years. All the computations have been carried out in Microsoft Excel 2013. The formula for the computation of the denominators are as follows:

1. *Crude birth rate (CDR)*: (Number of live births during a year / Population at mid-year) * 1,000.

Table 2: Age specific nutrition and health Indicators and suggested methodology for estimation in a life cycle holistic approach.

Days	Age group	Monitoring of the following interventions / micronutrients supplementation	Formula
First 1,000 days: First 1,000 days approach to maternal, neonatal, infant and child health			
-270 days (~9 months of gestation)	Annual Pregnancies	Antenatal care (ANC) + Tetanus Immunization + Birth package interventions + Iron and folic acid supplementation during pregnancy	(Number of births * pregnancy wastage (1.1 or based on fertility levels) / or through Age Specific Fertility Rates (ASFRs), if available.
0	Annual Births	Birth package interventions + Iron and folic acid supplementation during pregnancy + Kangaroo Mother Care	(Crude birth rate * Mid-year population)/ 1,000
0 to 179 days	Infants 0 to 5* months	Exclusive breastfeeding among 0 to 5 months infants	(Children 0 to 59 months)- (Children 6 to 59 months)
180 to 730 days	Children 6 to 23* months	Infant and Young Child Nutrition (IYCN) + Multiple Micronutrient Powder (MNP)	(Children 0 to 59 months)- (Infants 0 to 5 months- children 24 to 59 months)
0 to 1,000 days	9 months of pregnancy until a child is of 2 years	First 1,000 days approach to maternal and child health	9 months of pregnancy (9 months * 30 days per month =270 days) until a child is 2 years (365 days + 365 days=730 days) ; i.e., 270+730=1,000 days
Children under five years			
0 to 364 days	Infants 0 to 11* months	Immunization / Vaccination	(Children 0 to 59 months) * (1/59 months*47 months)
180 to 249 days	Infants 6 to 8* months	Initiation of complementary feeding+ MNPs	(Children 0 to 59 months)- (Infants 0 to 5 months)- (Infants/ Children 9 to 59 months)
180 to 364 days	Infants 6 to 11* months	Vitamin A supplementation + Initiation of complementary feeding during 6 to 8 months + MNPs	(Children 6 to 59 months)- (Children 12 to 59 months)
0 to 730 days	Children 0 to 23* months	Infant and Young Child Nutrition (IYCN) + MNPs	(Children 0 to 59 months)- (Children 24 to 59 months)
365 to 729 days	Children 12 to 23* months	Infant and Young Child Nutrition (IYCN) + MNPs	(Children 0 to 59 months)- (Infants 0 to 11 months- children 24 to 59 months)
180 to 1,799 days	Children 6 to 59* months	Vitamin A supplementation + Iron & Folic acid supplementation + zinc and ORS for diarrhoea management + MNPs	(Children 0 to 59 months) * (1/59 months*53 months)
270 to 1,799 days	Children 9 to 59* months	Vitamin A supplementation + MNPs	(Children 0 to 59 months) * (1/59 months*50 months)
365 to 1,799 days	Children 12 to 59* months	Vitamin A supplementation + MNPs	(Children 0 to 59 months) * (1/59 months*47 months)
0 to 1,799 days	Children 0 to 59 months	Vitamin A supplementation + Iron & Folic acid supplementation + zinc and ORS for diarrhoea management + MNPs	Available from census and estimates (population of 0 to 4 years)
2,160 to 4,319 days	Children 6 to 12 years	Multiple Micronutrient Powder (MNP)	Available from census and estimates (population of 6 to 12 years)
Adolescents			
3,600 to 6,839 days	Adolescent boys and girls of 10 to 19 years of age	Weekly Iron and Folic Acid Supplementation + Adequately Iodized salt + Double Fortified Salt + Fortified rice/ wheat /oil /ghee /milk /pulses etc.	Available from census and estimates (population of 10 to 19 years)

Continued.

Days	Age group	Monitoring of the following interventions / micronutrients supplementation	Formula
Women of reproductive age			
5,400 to 17,639 days	Women of reproductive age (15 to 49 years of age)	Daily Iron and Folic Acid Supplementation + Adequately Iodized salt + Double Fortified Salt + Fortified rice/ wheat /oil /ghee /milk /pulses etc.+ family planning	Available from census and estimates (population of 15 to 49 years)
Men aged 19 to 49 years of age			
6,840 to 17,639 days	Men aged 20 to 49 years of age	Life style diseases, nutritional deficiencies + Adequately Iodized salt + Double Fortified Salt + Fortified rice/ wheat /oil /ghee /milk /pulses etc.+ family planning	Available from census and estimates (population of 20 to 49 years)
Elderly			
18,000 days till disappearance of life	Elderly (50+ or 60+ or 65+ years)	Life style diseases, nutritional deficiencies + Adequately Iodized salt + Double Fortified Salt + Fortified rice/ wheat /oil /ghee /milk /pulses etc.	Available from census and estimates (population of 50+, 60+ or 65+ years)

Source: World Health Organization, UNICEF, IFPRI, University of UC Davis, FANTA 2, AED, USAID, (2010). Indicators for assessing infant and young child feeding practices: Part 1/Part 2: Definitions: Conclusions of a consensus meeting held 6–8 November 2007 in Washington D.C., USA.; *: Under the assumption that the proportion of population at each month is uniformly distributed within 0 to 59 months age group, which may or may not be applicable everywhere.

2. *Estimated Number of annual births:* (Crude birth rate/ 1,000) * population at mid-year. Alternatively, if we have age-specific fertility rates from 15 to 49 years in seven age groups, we could compute the annual births.
3. *Estimated Number of annual pregnancies:* Annual number of births*1.1 (Pregnancy wastage factor, which includes estimates of stillbirths, miscarriages, induced and spontaneous abortions). This factor of 1.1 may vary with varying levels of proportion of outcomes of pregnancies.

The age specific nutrition and health Indicators and suggested methodology for estimation in a life cycle holistic approach have been presented on Table 2.

RESULTS

Estimated number of annual pregnancies, births and proportion of 10 to 19 years, 10 to 24 years and 15 to 49 years population

Considering the crude birth rates and adjusting it for pregnancy wastage, the estimated births and pregnancies of these 13 countries comes to 79.7 million (World: 140.4 million) and 87.7 million (World: 154.5 million) for the year 2017. The number of estimated annual births range from 1.0 million in Japan to 25.0 million births in case of India and the pregnancies range from 1.1 million in Japan to 27.5 million in India. The proportion (as a fraction of one) of population of live births comes to 1.9 per cent (World: 1.9 per cent) varying from 0.8% in Mexico to 3.8% in Pakistan. The proportion of pregnancies comes to 2.1% (World: 2.0%) varying from 0.9% in Mexico to 4.2% in Pakistan. The proportion of adolescent of both sexes comes to 15.1% (World: 16.2%) varying from 9% in Japan to 24.3% in Ethiopia. The proportion of adolescent girls aged 10 to 19 years comes to 7.2% (World: 7.8%) varying from 4.4% in Japan to 12.1% in Ethiopia. The population per 1,000 total population has also been computed. The number of annual births per thousand population vary from 8 in Mexico to 38 in Pakistan and the number of annual pregnancies vary from 9 in Mexico to 42 in Pakistan. The number of adolescents of 10 to 19 years of age of both sexes in a population of 1,000 varies from 90 in Japan to 243 in Ethiopia. The number of adolescent girls of 10 to 19 years of age in a population of 1,000 varies from 44 in Japan to 121 in Ethiopia. The women of reproductive age aged 15 to 49 years vary from 203 in Japan to 280 in Bangladesh. The number of youth of both sexes in a population of thousand varies from 138 in Japan to 344 in Ethiopia (Table 3).

Estimated number of infants/ children under five years (0 to 59 months)

Using this method, the estimated number of infants 0 to 11 months comes to 79.4 million in these 13 countries (World:138 million) and 390 million children aged 0 to 59 months of age (World: 678 million). The number of infants varies from 2.0 million in Mexico, Japan, Philippines and Russian Federation to 24 million in India. The number of under five children varies from 5 million in Japan to 120 million in India. The proportion (as a fraction of one) of population of children aged 0 to 59 months of both sexes comes to 8 per cent (World: 9 per cent) varying from 4.2% in Japan to 17% in Nigeria. The proportion of population of infants in the age group of 0 to 11 months comes to 1.6% (World: 1.8%) varying from 0.8% in Japan to 3.4% in Nigeria. The children under the age of 18 years comes to 29.3% (World: 32%) varying from 16.6% in Japan to 51.5% in Nigeria. The population per 1,000 total population has also been computed. In order to plan programs and service delivery at a cluster of 200 households or 1,000 population, 100 households or 500 population and 50 households or 250 population, the proportions of infants and children have been computed per thousand population. The number of children 0 to 59 months vary from 42 per thousand population in Japan to 170 per thousand in Nigeria. The number of infants 0 to 5 months varies from 4 in Japan to 17 in Nigeria (Table 4 and 5).

Estimated population of adolescents (10 to 19 years), youth (10 to 24 years), children <18 years of both sexes, adolescent girls from 10 to 14 years, 15 to 19 years, 10 to 19 years of age and women of reproductive age from 15 to 49 years of age

Using this method, the estimated number of adolescents in the age group of 10 to 19 years comes to 741.8 million for these 13 countries (World:1,220.2 million). The estimated number of youth aged 15 to 24 years comes to 1062.4 million in these 13 countries (World: 1814.1 million) and children under 18 years comes to 1,377.9 (World: 2,419.3 million). The number of adolescent varies from 11.5 million in Japan to 251.9 million in India. The number of youth varies from 17.6 million in Japan to 371.7 million in India. The number of children under eighteen years varies from 21.1 million in Japan to 47.6 million in India. Using this method, the estimated number of adolescent girls in early adolescence in the age group of 10 to 14 years comes to 171.5 million for these 13 countries (World:301.0 million). The estimated number of girls in late adolescence aged 15 to 19 years comes to 167.1 million in these 13 countries (World: 288.5 million) and children under 18 years comes to 1,377.9 (World: 2,419.3 million). The number of adolescent girls in the age group of 10 to 19 years comes to 354.5 million (World: 589.5 million). The total population of women of reproductive age of 15 to 49 years comes to 1,189 million (World: 1,887 million) (Table 6).

Table 3: Estimated number of annual pregnancies, births and proportion of 10 to 19 years, 10 to 24 years and 15 to 49 years and estimated population of annual pregnancies, births, 10 to 19 years, 10 to 24 years and 15 to 49 years per 100 and per 1,000 total population, 2017.

		Annual number of pregnancies and births		Annual pregnancies, births, 10 to 19, 10 to 24 and 15 to 49 per 100 population						Annual pregnancies, births, 10 to 19, 10 to 24 and 15 to 49 per 1,000 population					
Country/ World	Crude birth rate (number of live births per 1,000 mid-year population (2015-2020)	Annual pregnancies (millions)	Annual live births (millions)	Annual births / 100	Annual pregnancies / 100	10 to 19 years (M +F)/ 100	10 to 19 years (F) / 100	Youth (10 to 24 years) (M+F) / 100	15 to 49 years (F) / 100	Annual Births/ 1,000	Annual Pregnancies/ 1,000	10 to 19 years (M +F)/ 1,000	10 to 19 years (F)/ 1,000	Youth (10 to 24 years) (M+F)/ 1,000	15 to 49 years (F)/ 1,000
Bangladesh	18.5	3.4	3.0	1.9	2.0	19.6	9.6	29.0	28.0	19	20	196	96	290	280
Brazil	13.8	3.2	2.9	1.9	2.1	15.7	7.7	24.0	27.4	19	21	157	77	240	274
China	11.6	18.0	16.4	2.7	3.0	11.2	5.2	17.6	25.1	27	30	112	52	176	251
Ethiopia	31.0	3.6	3.3	1.4	1.5	24.3	12.1	34.4	24.6	14	15	243	121	344	246
India	18.7	27.5	25.0	1.2	1.3	18.8	8.9	27.8	25.8	12	13	188	89	278	258
Indonesia	18.4	5.3	4.9	3.1	3.4	17.6	8.6	26.0	26.7	31	34	176	86	260	267
Japan	8.1	1.1	1.0	1.8	2.0	9.0	4.4	13.8	20.3	18	20	90	44	138	203
Mexico	17.6	2.5	2.3	0.8	0.9	18.0	8.8	26.9	27.3	8	9	180	88	269	273
Nigeria	38.1	8.0	7.3	1.8	1.9	22.8	11.2	31.5	22.9	18	19	228	112	315	229
Pakistan	27.4	5.9	5.4	3.8	4.2	20.1	9.6	29.6	25.2	38	42	201	96	296	252
Philippines	22.9	2.6	2.4	2.3	2.5	19.9	9.6	29.3	25.8	23	25	199	96	293	258
Russian Federation	12.4	2.0	1.8	1.2	1.4	9.5	4.6	14.8	23.6	12	14	95	46	148	236
United States of America	12.7	4.5	4.1	1.3	1.4	13.0	6.4	20.0	22.8	13	14	130	64	200	228
13,100 million plus countries total	-	87.7	79.7	1.9	2.1	15.1	7.2	22.6	24.3	19	21	151	72	226	243
WORLD	18.6	154.5	140.4	1.9	2.0	16.2	7.8	24.0	25.0	19	20	162	78	240	250

Note : Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248[1].

Table 4: Estimated population of infants/ children under five years of age, 2017 (in millions).

Country/ World	Children 0 to 59 months Total	Children 6 to 59 months	Children 9 to 59 months	Children 12 to 59 months	Infants (0 to 5 months)	Infants (6 to 11 months)	Children (12 to 23 months)	Children (24 to 59 months)	Children (6 to 23 months)
Bangladesh	15.0	14.0	13.0	12.0	2.0	2.0	3.1	9.0	4.6
Brazil	15.0	13.0	13.0	12.0	2.0	2.0	3.0	8.8	4.5
China	85.0	76.0	72.0	68.0	9.0	9.0	17.3	50.6	25.9
Ethiopia	15.0	14.0	13.0	12.0	2.0	2.0	3.1	9.1	4.7
India	120.0	108.0	101.0	95.0	12.0	12.0	24.4	71.1	36.5
Indonesia	25.0	22.0	21.0	20.0	3.0	3.0	5.0	14.7	7.5
Japan	5.0	5.0	4.0	4.0	1.0	1.0	1.1	3.1	1.6
Mexico	12.0	10.0	10.0	9.0	1.0	1.0	2.4	6.9	3.5
Nigeria	32.0	29.0	27.0	26.0	3.0	3.0	6.6	19.2	9.9
Pakistan	25.0	23.0	21.0	20.0	3.0	3.0	5.1	14.9	7.7
Philippines	12.0	10.0	10.0	9.0	1.0	1.0	2.4	6.9	3.5
Russian Federation	10.0	9.0	8.0	8.0	1.0	1.0	1.9	5.7	2.9
United States of America	20.0	18.0	17.0	16.0	2.0	2.0	4.0	11.7	6.0
13, 100 million plus countries total	390.2	350.5	330.7	310.8	39.7	39.7	79.4	231.7	118.8
WORLD	678.0	609.0	575.0	540.0	69.0	69.0	137.9	402.6	206.4

Note : Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

Table 5: Estimated population of infants/ children in different age groups per 100 and 1,000 total population, 2017.

	Per 100 total population										Per 1,000 total population									
Country/ World	**0 to 59 months (M +F)/ 100**	**6 to 59 months (M +F)/ 100**	**9 to 59 months (M +F)/ 100**	**12 to 59 months (M +F)/ 100**	**Infants (0 to 5 months) (M+F)/ 100**	**Infants (6 to 11 months) (M+F)/ 100**	**Children (12 to 23 months) (M+F)/ 100**	**Children (24 to 59 months) (M+F)/ 100**	**Children (6 to 23 months) (M+F)/ 100**	**Children < 18 years (M+F)/ 100**	**0 to 59 months (M +F)/ 1,000**	**6 to 59 months (M +F)/ 1,000**	**9 to 59 months (M +F)/ 1,000**	**12 to 59 months (M +F)/ 1,000**	**Infants (0 to 5 months) (M+F)/ 1,000**	**Infants (6 to 11 months) (M+F)/ 1,000**	**Children (12 to 23 months) (M+F)/ 1,000**	**Children (24 to 59 months) (M+F)/ 1,000**	**Children (6 to 23 months) (M+F)/ 1,000**	**Children < 18 years (M+F)/ 1,000**
Bangladesh	9.2	8.3	7.8	7.3	0.9	0.9	1.9	5.5	2.8	36.2	92	83	78	73	9	9	19	55	28	362
Brazil	7.1	6.4	6.0	5.6	0.7	0.7	1.4	4.2	2.2	28.3	71	64	60	56	7	7	14	42	22	283
China	6.0	5.4	5.1	4.8	0.6	0.6	1.2	3.6	1.8	22.0	60	54	51	48	6	6	12	36	18	220
Ethiopia	14.6	13.2	12.4	11.7	1.5	1.5	3.0	8.7	4.5	49.5	146	132	124	117	15	15	30	87	45	495
India	8.9	8.0	7.6	7.1	0.9	0.9	1.8	5.3	2.7	35.1	89	80	76	71	9	9	18	53	27	351
Indonesia	9.4	8.4	7.9	7.5	1.0	1.0	1.9	5.6	2.9	34.1	94	84	79	75	10	10	19	56	29	341
Japan	4.2	3.7	3.5	3.3	0.4	0.4	0.8	2.5	1.3	16.6	42	37	35	33	4	4	8	25	13	166
Mexico	8.9	8.0	7.6	7.1	0.9	0.9	1.8	5.3	2.7	33.9	89	80	76	71	9	9	18	53	27	339
Nigeria	17.0	15.2	14.4	13.5	1.7	1.7	3.4	10.1	5.2	51.5	170	152	144	135	17	17	34	101	52	515
Pakistan	12.8	11.5	10.8	10.2	1.3	1.3	2.6	7.6	3.9	42.2	128	115	108	102	13	13	26	76	39	422
Philippines	11.1	9.9	9.4	8.8	1.1	1.1	2.3	6.6	3.4	39.3	111	99	94	88	11	11	23	66	34	393
Russian Federation	6.6	5.9	5.6	5.3	0.7	0.7	1.3	3.9	2.0	20.8	66	59	56	53	7	7	13	39	20	208
United States of America	6.1	5.5	5.2	4.8	0.6	0.6	1.2	3.6	1.9	24.1	61	55	52	48	6	6	12	36	19	241
13, 100 million plus countries total	8.0	7.2	6.7	6.3	0.8	0.8	1.6	4.7	2.4	29.3	80	72	67	63	8	8	16	47	24	293
WORLD	9.0	8.1	7.6	7.2	0.9	0.9	1.8	5.3	2.7	32.0	90	81	76	72	9	9	18	53	27	320

Note : Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

Table 6 : Estimated population of adolescents (10 to 19 years), youth (10 to 24 years), children <18 years of both sexes, adolescent girls from 10 to 14 years, 15 to 19 years, 10 to 19 years of age and women of reproductive age from 15 to 49 years of age, 2017 (in millions), 2017.

Country/ World	Adolescents (10 to 19 years, M+F)	Youth (10 to 24 years, M+F)	Children < 18 years, M+F	Early adolescence : Adolescent girls (10 to 14 years)	Late adolescence : Adolescent girls (15 to 19 years)	Early and Late Adolescence: Adolescent girls (10 to 19 years)	Total population of 15 to 49 years women of reproductive age
Bangladesh	32.3	47.8	59.6	7.9	7.9	15.8	46.0
Brazil	32.9	50.2	59.3	7.7	8.4	16.1	57.0
China	158.0	248.4	310.0	37.0	36.4	73.4	354.0
Ethiopia	25.5	36.1	52.0	6.5	6.1	12.7	26.0
India	251.9	371.7	470.6	60.1	58.9	119.0	346.0
Indonesia	46.6	68.5	90.1	11.5	11.1	22.6	71.0
Japan	11.5	17.6	21.1	2.7	2.9	5.6	26.0
Mexico	23.3	34.7	43.8	5.6	5.8	11.4	35.0
Nigeria	43.6	60.1	98.4	11.6	9.8	21.4	44.0
Pakistan	39.5	58.2	83.2	9.7	9.3	19.0	50.0
Philippines	20.8	30.7	41.2	5.1	5.0	10.1	27.0
Russian Federation	13.7	21.2	30.0	3.6	3.1	6.7	34.0
United States of America	42.1	64.9	78.2	10.2	10.4	20.6	74.0
13, 100 million plus countries total	741.8	1,062.4	1,377.9	171.5	167.1	354.5	1,189.0
WORLD	1220.2	1814.1	2,419.3	301.0	288.5	589.5	1,887.0

Note: Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

Table 7: Estimated number of currently pregnant women (PW), Women of reproductive age (WRA), infants and children aged 0 to 23 months per 1,000, 500 and 250 total population for the first 1,000 days monitoring and estimated number of pregnant women (PW), lactating women (LW) and non-pregnant and non-lactating women (NPNL) per 1,000 total population (%) among the women of reproductive age (WRA, 15 to 49 years, 2017.

	Population of first thousand (1,000) days					Population of women of reproductive age in different stages : pregnancy, lactation, no-pregnancy and no-lactation							
Country/ World	**NFHS-4, 2015-16*** (Currently pregnant of WRA (4.4%)**	**Infants (0 to 5 months) (M+F)**	**Children (6 to 23 months) (M+F)**	**WRA PW + Infant 0-5m + Infants/ Children 6-23m (M + F)**	**WRA : 15 to 49 years (F)**	**Number of Annual Births**	**Number of Annual Pregnancies**	**PW @ 0.5 of the annual pregnancies in any given month***	**PW @0.7 of the annual pregnancies in a given month****	**NFHS-4, 2015-16*** (Currently pregnant of WRA (4.4%)**	**NPNL (WRA-PW (4.4% estimate-LW)**	**Infants (0 to 5 months) (M+F) as a proxy for lactating women (LW)**	**WRA : 15 to 49 years (F)**
Bangladesh	12	9	28	49	280	19	20	10	14	12	259	9	280
Brazil	12	7	22	41	274	19	21	11	15	12	255	7	274
China	11	6	18	35	251	27	30	15	21	11	234	6	251
Ethiopia	11	15	45	71	246	14	15	8	11	11	220	15	246
India	11	9	27	47	258	12	13	7	9	11	238	9	258
Indonesia	12	10	29	51	267	31	34	17	24	12	245	10	267
Japan	9	4	13	26	203	18	20	10	14	9	190	4	203
Mexico	12	9	27	48	273	8	9	5	6	12	252	9	273
Nigeria	10	17	52	79	229	18	19	10	13	10	202	17	229
Pakistan	11	13	39	63	252	38	42	21	29	11	228	13	252
Philippines	11	11	34	56	258	23	25	13	18	11	236	11	258
Russian Federation	10	7	20	37	236	12	14	7	10	10	219	7	236
United States of America	10	6	19	35	228	13	14	7	10	10	212	6	228
13, 100 million plus countries average	11	8	24	43	243	19	21	11	15	11	224	8	243
WORLD per 1,000 population (~200 Households)	11	9	27	47	250	19	20	10	14	11	230	9	250
WORLD per 500 population (~100 Households)	6	5	14	24	125	9.5	10	5	7	5.5	115	4.5	125
WORLD per 250 population (~50 Households)	2.8	2.3	6.8	11.8	62.5	4.75	5	2.5	3.5	2.75	57.5	2.25	62.5
% of WRA, 15 to 49 years	4	4	11	19	100	-	-	4.0	5.6	4.4	92.0	3.6	100

Note : Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. Source : International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.

Table 8: Estimated population of major age groups of population per 100 and per 1,000 total population, 2017.

	Per 100 total population							Per 1,000 total population						
Country/ World	**0 to 4 years (M +F)/ 100**	**5 to 9 years (M+F)/ 100**	**10 to 14 years (M+F)/ 100**	**15 to 49 years (M+F)/ 100**	**50 to 59 years (M +F)/ 100**	**60+ years (M+F)/ 100**	**Total Population**	**0 to 4 years (M +F)/ 1,000**	**5 to 9 years (M+F)/ 1,000**	**10 to 14 years (M+F)/ 1,000**	**15 to 49 years (M+F)/ 1,000**	**50 to 59 years (M +F)/ 1,000**	**60+ years (M+F)/ 1,000**	**Total Population**
Bangladesh	9.2	9.4	9.8	56	8.3	7.3	100	92	94	98	560	83	73	1,000
Brazil	7.1	7.1	7.6	54.6	11.0	12.6	100	71	71	76	546	110	126	1,000
China	6.0	6.0	5.7	52.1	14.0	16.2	100	60	60	57	521	140	162	1,000
Ethiopia	14.6	13.3	12.6	49.3	4.9	5.3	100	146	133	126	493	49	53	1,000
India	8.9	9.3	9.5	53.9	9	9.4	100	89	93	95	539	90	94	1,000
Indonesia	9.4	9	9	54.1	9.9	8.6	100	94	90	90	541	99	86	1,000
Japan	4.2	4.3	4.4	41.4	12.4	33.4	100	42	43	44	414	124	334	1,000
Mexico	8.9	8.8	8.9	54.6	8.6	10.1	100	89	88	89	546	86	101	1,000
Nigeria	17	14.6	12.4	46.4	5.1	4.5	100	170	146	124	464	51	45	1,000
Pakistan	12.8	11.7	10.3	51.6	6.9	6.7	100	128	117	103	516	69	67	1,000
Philippines	11.1	10.6	10.1	52.4	8.2	7.6	100	111	106	101	524	82	76	1,000
Russian Federation	6.6	5.9	5.1	47	14.3	21.1	100	66	59	51	470	143	211	1,000
United States of America	6.1	6.4	6.5	46.2	13.4	21.5	100	61	64	65	462	134	215	1,000
13, 100 million plus countries total	8.3	8.2	8.0	51.9	10.8	12.9	100	83	82	80	519	108	129	1,000
WORLD	9.0	8.7	8.3	51.0	10.3	12.7	100	90	87	83	510	103	127	1,000

Note: Author's computations based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248

Estimated number of currently pregnant women, infants and children aged 0 to 23 months per 1,000, 500 and 250 total populations for a first thousand days approach to service delivery and program monitoring

For a first thousand day approach to service delivery, rationalization of workload, we need to know the number pregnant women, number of 0 to 5 months post-partum mothers and mothers of 6 to 23 months infants/ children. The assumption here does not take into consideration, late child bearing after 49 years of age, which may be a few. Considering the recent DHS survey estimates of 4.4% of currently pregnant women, the number of currently pregnant women varies from 9 in Japan to 12 each in Bangladesh, Brazil, Indonesia and Mexico. The number of 0 to 5 months post-partum mothers as a proxy of 0 to 5 months children varies from 4 in case of Japan to 17 in case of Nigeria. The number of mothers of 6 to 23 months children varies from 13 in case of Japan to 52 in case of Nigeria.

Estimated number of pregnant women (PW), lactating women (LW) and non-pregnant and non-lactating women (NPNL) per 1,000 total population (%) among the women of reproductive age (WRA, 15 to 49 years) to monitor women of reproductive age in different stages of pregnancy, lactation and non-pregnant and non-lactation

In surveys and program, services delivery planning and monitoring, we also need estimates of pregnant, lactating and NPNL women. This has been estimated by different methods per thousand total populations. The annual pregnancies have been estimated per thousand total population and using three references, an estimate of 0.5 of them being pregnant in a given month or 0.7 being pregnant in a given month out of the annual estimated pregnancies and 4.4% being currently pregnant among women of reproductive age has been considered for the estimation. 0.7 is a weighted estimate of full-term pregnancies plus those pregnancies that terminate early. The estimate from using 50% of the annual pregnancies varies from 5 in Mexico to 21 in Pakistan. The estimates using 70% of the annual pregnancies varies from 6 in Mexico to 29 in Pakistan per thousand population in a given month. The survey estimate of 4.4% of women or reproductive age varies from 9 in Japan to 12 each in Bangladesh and India. The number of NPNL has been estimated by subtracting the pregnant women, lactating women from the total number of women of reproductive age in a thousand population (Table 7).

Estimated population of major age groups per 1,000 total population

The population elderly (60+ years) has also been estimated per 1,000 populations for program planning purposes. The number of 60+ years; men and women in a thousand populations varies from 45 in Nigeria to 334 in Japan. The per cent of population of elderly (60+) varies from 4.5% in Nigeria to 33.4% in Japan with the world average being 12.7%, following the stage of demographic transition in these two countries (Table 8).

Indonesia field data validation

This was also validated at the field level in a puskesmas area, which is a health facility in Indonesia. Indonesia with a population of 264 million is an archipelago consisting of approximately 13,466 islands and is administratively divided into 34 provinces. Based on the Regulation of the Minister of Home Affairs No. 39, year 2015 regarding codes and data of Administrative Regions, Indonesia is administratively divided into 34 provinces, 514 districts/municipalities (comprising 416 districts and 98 municipalities), 7,094 sub-districts, 8,412 administrative villages (Indonesian: Kelurahan) and 74,093 villages. As of December 2013, there were 9,754 Puskesmas in the country, which provides basic and additional health programs. A puskesmas covers a number of *Desa.* A *Desa* is divided into several RW and one RW is divided into several RT based on population, reach and terrain. The values at the grassroots level health facilities in both the countries are similar to the values estimated at the macro country level. The details of population of children under five years and the proportions have been presented in the Table 9.

Philippines field data validation

Philippines is an archipelago of approximately 7,641 islands with 104.9 million population. It is administratively divided into 17 regions, 81 provinces, 145 cities, 1,489 municipalities and 42,036 *Barangays* as of Sep 30, 2016. The *Barangays* are further divided into cluster of households called *Puroks/ Sitios* for better planning and service delivery. A *sitio* in the Philippines is a territorial enclave that forms part of a barangay. Typically rural, a *sitio's* location is usually far from the center of the barangay itself and could be its own barangay if its population were high enough. *Sitios* are similar to *puroks*, but the latter are more urban and closer to the barangay's center, especially the barangay hall. The *sitio* does not have an independent administration; it is established purely for organisational purposes. This population proportion data was also validated in a rural health unit consisting of 22 *barangays*, 22 *barangay* health stations are there. These are grassroots health facilities in Philippines. The details of population of children under five years and 0 to 5 months and the proportions have been presented in the table below for 22 Barangays in a Rural Health Unit in a municipality in Philippines. This RHU has 10 Rural Mid-wives (RMF) for 19 *Barangay* Health Stations (BHS), supported by 109 *Barangay* Health Workers (BHWs) and 22 *Barangay* Nutrition Scholars (BNSs). So, there is one BNS per one BHS, while there are about 5 to 6 BHWs per BHS (Table 10).

Table 9: Population of a *Puskesmas* catchment area in Indonesia, as on December 2017.

Sl. No.	Desa	Total Population	0 to 59 months population	% of 0 to 5 months out of total population	0 to 5 months population	% of 0 to 5 months out of total population
1	Sepatan	12,123	1,215	10.0	146	1.2
2	Pandok Jaya	9,922	995	10.0	120	1.2
3	Karet	35,535	3,562	10.0	429	1.2
4	Pisangan Jaya	25,100	2,516	10.0	393	1.6
5	Kayu Agung	11,948	1,197	10.0	188	1.6
6	Sarakan	12,566	1,259	10.0	197	1.6
7	Kayu Bongkok	6,091	611	10.0	95	1.6
8	Mekarjaya	9,762	978	10.0	121	1.2
	Total for Sepatan Puskesmas	123,047	12,333	10.0	1,689	1.4
	Indonesia			9.4		1.0

Source: Puskesmas, Sepatan

Table 10: Population of a rural health unit (RHU) in a municipality in Philippines, as on February, 2018.

Sl. No.	Barangays	Total Population	Number of 0 to 59 months children	% of 0 to 59 months out of total population	Number of 0 to 5 months infants	% of 0 to 5 months of the total population
1	Balaas	813	80	9.8	4	0.5
2	Balisong	2,169	240	11.1	12	0.6
3	Bogo	3,666	355	9.7	17	0.5
4	Butong	996	81	8.1	4	0.4
5	Bug-ot	911	83	9.1	2	0.2
6	Calagasan	1,094	93	8.5	7	0.6
7	Canbantug	870	98	11.3	2	0.2
8	Canbanua	2,584	202	7.8	11	0.4
9	Casay	910	86	9.5	5	0.5
10	Catang	633	73	11.5	4	0.6
11	Conalum	603	50	8.3	4	0.7
12	Jomgao	1,145	96	8.4	1	0.1
13	Lamacan	2,735	198	7.2	11	0.4
14	Lapay	704	59	8.4	2	0.3
15	Linut-od	1,057	92	8.7	3	0.3
16	Panadtaran	604	60	9.9	5	0.8
17	Tabayag	921	88	9.6	3	0.3
18	Talaga	3,617	334	9.2	18	0.5
19	Talaytay	1,738	151	8.7	3	0.2
20	Tiguib	892	110	12.3	10	1.1
21	Tulic	2,891	271	9.4	10	0.3
22	Usmad	1,173	65	5.5	3	0.3
	Total for RHU-2	32,726	2,965	9.1	141	0.4
	Philippines			11.1		1.1

Source: Rural Health Unit-2, Argao Municipality

DISCUSSION

Denominator estimation is carried out for program monitoring but detailed guidance on it is relatively rare in the literature. So, it is an attempt to standardize the process of denominator estimation, which could facilitate the process of program planning, budgeting and monitoring of program performance. Though denominator estimations are a regular part of monitoring of any program, it needs a lot of standardization. This is an attempt at standardizing this methodology in selected countries. These denominators could also be useful for estimation of different health products, micronutrients and health services at the grassroots level at a cluster of

about 200 households or about a thousand population, assuming a mean household size of about five persons per household.

CONCLUSION

Denominator estimation for program monitoring at regular intervals is a veritable necessity at every level of health system to obtain the pulse of the program, facilitating the path towards effective course correction. In order to obtain more realistic estimates at the different administrative levels, it is recommended to undertake this computation at sub-national levels, which could facilitate program planning and monitoring at sub-national levels and used for program course corrections to achieve the broader goals of SDGs.

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