

# Factors Influencing Immunisation Schedule Adherence and Completion at the Regional Level in the Philippines

## Faktor-faktor yang Memengaruhi Kelengkapan dan Kepatuhan Jadwal Imunisasi pada Tingkat Regional di Filipina

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### Abstract

The leading causes of infant deaths are largely preventable and there are reasons from both the supply and the demand sides of healthcare why they may be perpetuating. This study aimed to ascertain factors affecting the preventive healthcare behaviour of immunisation of infants in the Philippines which is timely because completion, or adherence, rate had plateaued in recent decades. The method employed was the creation of statistical models at sub-national level. The sample contained infants born prior to the 2013 Philippines National Demographic and Health Survey to determine proper adherence to the government-mandated immunisation schedule. This involved merging the 17 administrative regions of the country to the traditional three sub-national regions. It is observed that the higher maternal education level and improved household socioeconomic status were the most indicative factors of improved adherence across all regions. This is also the case to some extent with more advanced maternal ages at giving birth. Autonomy of mothers to visit healthcare facilities depicts conflicting relations for different regions as well as how mothers behave depending on the nature of intention to give birth. These aspects regarding predictive factors of preventive care have yet to be studied keenly at the regional level in the Philippines.

**Keywords:** Infant health, infant immunisation, health behaviour, maternal healthcare, Philippines

### Abstrak

Penyebab utama kematian bayi sebagian besar dapat dicegah dan terdapat alasan baik dari sisi suplai maupun permintaan layanan kesehatan hal itu dapat terus berlangsung. Penelitian ini bertujuan memastikan faktor-faktor yang memengaruhi perilaku layanan kesehatan preventif imunisasi bayi di Filipina yang tepat waktu karena tingkat kelengkapan, atau kepatuhan, telah stabil dalam beberapa dekade terakhir. Metode yang digunakan adalah pembuatan model statistik di tingkat subnasional. Sampel berisi bayi yang lahir sebelum Survei Demografi dan Kesehatan Nasional Filipina tahun 2013 untuk menentukan kepatuhan yang tepat terhadap jadwal imunisasi yang dimandatkan oleh pemerintah. Hal ini melibatkan penggabungan 17 wilayah administratif negara ke tiga wilayah subnasional tradisional. Diamati bahwa tingkat pendidikan ibu yang lebih tinggi dan peningkatan status sosial ekonomi rumah tangga merupakan faktor yang paling menunjukkan peningkatan kepatuhan di semua wilayah. Sampai taraf tertentu juga halnya dengan usia ibu yang lebih tua pada saat melahirkan. Otonomi ibu untuk mengunjungi fasilitas kesehatan menggambarkan hubungan yang saling bertentangan untuk daerah yang berbeda, serta bagaimana ibu berperilaku tergantung pada niat dasar untuk melahirkan. Aspek-aspek mengenai faktor prediktif layanan preventif ini belum dipelajari secara mendalam pada tingkat regional di Filipina.

**Kata kunci:** Kesehatan bayi, imunisasi bayi, perilaku kesehatan, layanan kesehatan ibu, Filipina

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## Introduction

Immunisations are an efficient and effective intervention for infants especially in the developing regions of the world.<sup>1</sup> When infants are born at term, their bodies have a certain level of protection but subsequently, they will be prone to infections if there is improper adherence to immunisations. These immunisations protect them from measles and mumps among others but this afforded immunity may wane months after immunisation, therefore, booster shots are required to sustain immunological response.<sup>2</sup> Given these benefits toward the health of infants, there remains gaps on accessibility across populations.

A study observed that child survival improves with immunisations, but there are disparities within and between countries' cities when inter-urban comparisons are made.<sup>3</sup> This has been a requirement in the Philippines for pregnant women to have safer childbirth because it prevents certain infections based on the Ministry of Health, programme guideline.<sup>4</sup> It has been shown in literature that receiving inoculation, tetanus toxoid specifically, allows the infant to avoid being infected by other diseases.<sup>5</sup>

Even with the stated guidelines of the government, there are indications that it is still not practiced by many as a setting whereby resources may be limited, issues are faced from the supply and demand sides. For the government as provider of service, there are issues regarding equity, allocative and technical efficiency, and quality of care.<sup>6</sup> Health care delivery sites are adequate in the regional level because of budget allocation from the national government; but local government units have predicaments because population size is the basis for physical access to service.<sup>7</sup> On the demand side, the people's perception of healthcare access reflects what the government side lacks. According to a study in Central Philippines, women with families have a certain view of the public health care system whereby they may be unable to gain access due to lack of financial resources.<sup>8</sup>

Then the aim of this study was to determine what may be in need of addressing to address the behaviour of mothers for them to comply with required schedule of immunisation. Presentation of the variables would be divided into three macro-regions whereby the 17 administrative regions of the Philippines have been clustered. This was done to present the experience of each region rather than having the said regions as a single variable to display where it is most likely to have better adherence. This contributes to the literature for the country because there is a general lack of regional level analysis which is needed because each region has its unique experience due to the policy of governance which is partly devolved giving each city or municipality its own priorities in terms of delivery of healthcare services.

## Method

The current study utilises the Proximate Determinants Model. Mosley's and Chen's,<sup>9</sup> model where personal illness control are factors that the mother take for herself and her infant; which include the inoculation schedule. This schedule is detailed in the Philippines National Demographic and Health Surveys (NDHS). As a standardised instrument, it reports complete birth records of women aged 15 to 49 years. The 2013 NDHS had been from a stratified two-stage sample design.<sup>10</sup> The sample involved was limited to the last child born to every woman. The infants belonging to this sample from this point will be referred to as the 'index infant'. Censored in the sample were those born in 12 months prior to the 2013 NDHS enumeration. The resulting sample size was 3,951 infants.

The Ministry of Health in the Philippines follows international standards which require specific drugs to be administered at the proper timing within the first year of life.<sup>7</sup> There are six vaccinations that are *Bacillus Calmette-Guérin* vaccine, BCG, which is for tuberculosis is to be administered at the first month from birth; the Diphtheria, Pertussis, and Tetanus, DPT, I and II which are to be vaccinated the 6-to 16-week-old and 14-week to 6-month old infants respectively; the Oral Polio Vaccine, OPV, I and II which have the same timing of administration as the DPT's I and II; and lastly, the Measles Vaccine to be introduced between the eighth and the twelfth months of life. The outcome variable is presented as dichotomous, whether incomplete or complete immunisation referring to the prescribed schedule.

Parental behaviour for the purposes of the current study matters based on the proximate determinants model whereby its strength is the incorporation of social, behavioural, and bio medical paradigms. The individual-level factors tested were sex of the infant, the respondent's education level as well as the spouse's; respondent's age at the time of birth of the index infant, and lastly the intention to birth at the time of conception. Household- and community-level factors were the socio-economic status and the residence of the infant at time of enumeration respectively.

Each regional area is presented by respective regression model. The division of the 17 administrative regions is National Capital Region, Cordillera Administrative Region and Regions 1, 2, 3, 4-A, 4-B, and 5 are grouped into Luzon. Regions 6 through 8 form the area of Visayas. Regions to include 9 through 13 and the Autonomous Region for Muslim Mindanao to form Mindanao. This grouping pertains to the locational grouping of the islands and administrative localities.<sup>11</sup>

The samples for each region were determined to be sufficient as they satisfy the assumptions of a binomial logistic regression analysis.<sup>12</sup> The odds ratios are pro-

duced to present the likelihood of the outcome of having a completed inoculation schedule. Appropriate diagnostic statistics were utilised including Hosmer-Lemeshow Test and F-Static.

## Results

Table 1 shows the distribution of selected characteristics of the sample which are pertinent to the subsequent analysis. Adherence to the set schedule by the Ministry of Health of the country among infants was at 80% at the national level. The Visayas had the highest adherence to prescribed schedule at 86%, while the Mindanao area was about 73%.

The observed education levels of mothers displayed that majority of women in Luzon had secondary qualifications and the next was having had tertiary education level. This pattern was also observed for Visayas, while those in Mindanao had mostly below secondary. For the father's education levels, those from Luzon had the similar pattern as that of the mothers, but Visayas and Mindanao shared the similar distribution with more having had elementary level or below.

Urban-rural residence dichotomy had shown that Luzon had a larger percentage of being urban at 50%; Visayas was at 30% and Mindanao had a slight more at 35%. Majority of those in the latter two regional areas had low socioeconomic status for their households with 58% and 71% respectively.

The age of the mothers at the time of birth of the sam-

ple had been observed that across all regions it was the age group of 20 to 29 years that had given birth to an infant in the period prescribed in this study prior to the 2013 NDHS. On the other hand, Mindanao is displayed to have the highest percentage of those who gave birth to an index infant at almost 12%.

At the national level, 88% of women are autonomous or have a degree of decision-making capacity with regards to visiting a health facility. All the regional areas display this level. Then for the final characteristic, the intention of giving birth to the index infant, Visayas had the highest unintentional birth, while Luzon and Mindanao were highly similar.

In Table 2, the figures observed were based on those who had or were having a proper adherence to the inoculation schedule. For Table 2, where the observations for Luzon are displayed, it is presented that adherence by sex did not differ as much both at almost 83%. Mothers with tertiary qualifications had the highest adherence as it is the case with those being in the high socioeconomic status in their respective characteristic categories. Also, those in urban areas tended to have higher completeness than their rural counterpart.

The mothers of index infants who had given birth at 20 years and above were at 83%, while those at 19 years and below only had 76% of themselves who were fully compliant with the immunisation schedule. Autonomy on decision making bear no difference in adherence unlike in the category of intention to give birth where wom-

**Table 1. Distribution of Infants by Selected Characteristics by Macro-regional and National Levels**

Variable	Category	Sub-national Levels			
		The Philippines	Luzon	Visayas	Mindanao
Immunisation status	Incomplete	19.94	17.21	13.63	27.37
	Complete	80.06	82.79	86.37	72.63
Sex of infant	Female	47.81	47.84	51.35	46.03
	Male	52.19	52.16	48.65	53.97
Mothers' completed education	Elementary and below	23.54	17.21	22.98	33.83
	Secondary	48.14	50.74	47.07	44.56
	Tertiary	28.32	32.06	29.95	21.62
Fathers' completed education	Elementary and below	30.12	21.04	34.87	42.15
	Secondary	43.76	50	38.83	37.01
	Tertiary	26.12	29.4	26.31	21
Residence	Rural	57.93	50.15	69.73	64.46
	Urban	42.07	49.85	30.27	35.54
Maternal age at childbirth	19 years and below	10.68	10.57	8.72	11.82
	20 to 29 years	48.57	49.46	46.12	48.37
	30 years and above	40.74	39.97	45.17	39.81
Socioeconomic status	Low	49.76	34.07	57.69	70.68
	Middle	19.72	23.16	20.13	14.07
	High	30.52	42.77	22.19	15.24
Mothers' involvement in decision to visit healthcare facility	Lacking involvement	11.97	12.19	10.78	12.21
	Involved	88.03	87.81	89.22	87.79
Intention of birth of infant	Unintended	28.4	27.48	33.6	27.29
	Wanted	71.6	72.52	66.4	72.71
<b>Total</b>		<b>3,951</b>	<b>2,034</b>	<b>631</b>	<b>1,286</b>

Table 2. Sub-national Level Percentage Distribution of Infants by Selected Characteristics and Adherence to Immunisation Schedule and Respective Odds Ratio

Region	Variable	Category	Percentage of Adherence to Immunisation Schedule				Confidence Interval	
			Total	Incomplete	Complete	Odds Ratio	Upper	Lower
Luzon	Sex of infant	Female	973	17.16	82.84	Ref	0.77	1.23
		Male	1061	17.25	82.75	0.98	1.14	2.12
	Mothers' completed education	Elementary and below	350	27.43	72.57	Ref		
		Secondary	1032	17.54	82.46	1.55**		
		Tertiary	652	11.2	88.8	2.14*	1.41	3.26
	Fathers' completed education	Elementary and below	428	22.43	77.57	Ref		
		Secondary	1008	18	82.14	0.91	0.67	1.25
		Tertiary	598	12.37	87.63	0.98	0.64	1.49
	Residence	Rural	1020	20.1	79.9	Ref		
		Urban	1014	14.3	85.7	1.17	0.90	1.52
	Mother's age at childbirth	19 years and below	215	22.33	77.67	Ref		
		20 to 29 years	1006	16.3	83.7	1.35	0.93	1.97
		30 years and above	813	16.97	83.03	1.42*	0.97	2.08
	Socioeconomic status	Low	693	23.52	76.48	Ref		
		Middle	471	18.05	81.95	1.20	0.87	1.65
		High	870	11.72	88.28	1.62**	1.14	2.31
	Mothers' autonomy to visit healthcare	Lacking involvement	248	16.13	83.87	Ref		
		Involved	1786	17.36	82.64	0.96	0.66	1.39
	Intention of birth of infant	Unintended	559	20.75	79.25	Ref		
		Wanted	1475	15.86	84.14	1.35**	1.05	1.74
Visayas	Sex of infant	Female	324	13.27	82.84	Ref		
		Male	307	14.01	82.75	0.94	0.59	1.49
	Mothers' completed education	Elementary and below	145	22.07	77.93	Ref		
		Secondary	297	13.8	86.2	1.45	0.81	2.60
		Tertiary	189	6.88	93.12	2.59**	1.06	6.34
	Fathers' completed education	Elementary and below	220	19.09	80.91	Ref		
		Secondary	245	12	87.76	1.09	0.60	1.98
		Tertiary	166	8.43	91.57	1.09	0.46	2.61
	Residence	Rural	440	14.32	85.68	Ref		
		Urban	191	12.04	87.96	1.01	0.59	1.75
	Mother's age at childbirth	19 years and below	55	10.91	89.09	Ref		
		20 to 29 years	291	12.03	87.97	0.68	0.26	1.78
		30 years and above	285	15.79	84.21	0.54	0.21	1.41
	Socioeconomic status	Low	364	17.86	82.14	Ref		
		Middle	127	7.09	92.91	2.37**	1.09	5.18
		High	140	8.57	91.43	1.57	0.70	3.50
	Mothers' autonomy to visit healthcare	Lacking involvement	68	17.65	82.35	Ref		
		Involved	563	13.14	86.86	2.08**	1.00	4.31
	Intention of birth of infant	Unintended	212	13.21	86.79	Ref		
		Wanted	419	13.84	86.16	1.04	0.63	1.74
Mindanao	Sex of infant	Female	592	25.34	82.84	Ref		
		Male	694	29.11	82.75	0.84	0.65	1.09
	Mothers' completed education	Elementary and below	435	40.92	59.08	Ref		
		Secondary	573	22.34	77.66	1.59**	1.17	2.18
		Tertiary	278	16.55	83.45	1.89**	1.17	3.05
	Fathers' completed education	Elementary and below	542	38.75	61.25	Ref		
		Secondary	476	20	80.46	1.73*	1.25	2.39
		Tertiary	268	18.28	81.72	1.38	0.87	2.20
	Residence	Rural	829	31.48	68.52	Ref		
		Urban	457	19.91	80.09	1.28	0.94	1.74
	Mother's age at childbirth	19 years and below	152	22.37	77.63	Ref		
		20 to 29 years	622	26.05	73.95	0.85	0.55	1.32
		30 years and above	512	30.47	69.53	0.72	0.46	1.13
	Socioeconomic status	Low	909	32.56	67.44	Ref		
		Middle	181	14.36	85.64	1.84**	1.15	2.95
		High	196	15.31	84.69	1.51***	0.91	2.52
	Mothers' autonomy to visit healthcare	Lacking involvement	157	26.11	73.89	Ref		
		Involved	1129	27.55	72.45	1.08	0.72	1.63
	Intention of birth of infant	Unintended	351	20.8	79.2	Ref		
		Wanted	935	29.84	70.16	0.70**	0.51	0.95

Notes: \*p &lt; 0.001; \*\*p &lt; 0.05; \*\*\*p &lt; 0.1

en who gave birth intentionally were at 84%.

It is observed based on the multivariate analysis that the most observable significance was with mothers' levels of education whereby having secondary qualification increased the likelihood of adherence by 1.55 and having tertiary qualification by 2.14. Having high SES also increased the odds as seen in Table 2. Giving birth at their 30s at least was also observed to be positively significant increasing the odds of immunisation adherence by 42%. Lastly, those births of a wanted nature had been observed to increase the odds by 1.35.

Table 2 displays bivariate and multivariate results for the regional area of Visayas. As observed in Luzon, sex of the infant was also similar to one another referring to their level of inoculation adherence. Both parents' education level also displayed the similar pattern of increasing adherence as education qualification increased. The urban and rural area had very similar adherence level at 88 and 86% respectively.

The difference observed with Luzon was the adherence to the inoculation schedule according to the age of mother upon giving birth to the index infant. Those who gave birth at 19 years and below had the highest adherence for Visayas at 89% and it continued to decrease from that level as age group of giving birth increased. Another difference with Luzon was in socioeconomic status and the household's adherence because those belonging to middle SES was observed to have the highest adherence and the weakest adherence is for those in the low SES. Women with involvement in decision making to head to health care facility was also seen to have higher adherence at 86%. There was no difference between those with unintended and intended births when pertaining to their adherence.

Based on the multivariate analysis, having tertiary education for a qualification increased the odds of adherence to immunisation schedule for their infants by 2.59. Being in the middle socioeconomic status was also observed to be statistically significant with increasing the odds of adherence by 2.37. Lastly, for Visayas, women's involvement in decision making process of healthcare itinerary increased the likelihood to adherence by as much as 108%.

Table 2 shows figures for Mindanao area. The adherence pattern is similar from that of Visayas' when referring to sex of infant, parents' education levels, residence, maternal age at giving birth to index infant, and socioeconomic status. Distinguishable here was the slightly higher adherence to immunisation schedule for infants with mothers lacking involvement in decision making about 74% compared to those involved at 72%. Having a wanted birth had shown also a lower adherence rate at 70%, while those from unintended births were at 79%.

Secondary and tertiary levels of education of the

mother had statistically significant odds of improving adherence by 1.59 and 1.89 respectively. Father's education at the secondary level had also shown to increase the odds by 1.73. Belonging to households with middle and high socioeconomic status also increased the likelihood of adherence. The factor that differed was from the nature of the intention of birth; those of wanted births decreased the likelihood by 30% compared to those from unintentional births.

## Discussion

This study focuses on the factors or the context that surrounds the circumstance of having complete immunisation; and by 'complete' it should be indicated again that it is depicted as timely with regards to the recommended period of immunisation of the infant according to the Ministry of Health. It had been observed that the samples for the regional area varied with a range of having as few as 631 to as many as 2034.

Firstly, it is observed in the data that sex of the infant was not a statistically significant factor. According to a study, there is no indication that Filipino parents regardless of location in the country has a particular preference referring to the sex of their child.<sup>13</sup> Other countries have observed this to have an impact to the phenomenon as in India.<sup>14</sup> Some argued that the cultural distinction of the sex of the child and their subsequent utility as adults is attributable to this preference but for the Philippines, there appears to be valuation for both that is rooted in its past when boys will contribute to an agricultural society for subsistence and girls will contribute to household work.<sup>13,14</sup> It may be therefore in the interest of parents in the Philippines to care for both sexes although this point would have to be known further.

Disparities have been determined on certain social characteristics whereby there are factors that improve it between societies and even within a society. Among such factors are maternal education as observed by Basu and Stephenson,<sup>15</sup> and Kravdal,<sup>16</sup> and household wealth as shown by Pamuk and colleagues.<sup>17</sup> These are the generally observed factors between societies but there are country-specific contexts that relate to the propensity. For the current study, it is observed that mother's education level is the most indicative of improved adherence, as well as more advanced maternal ages at giving birth, to completing immunisation schedule among infants rather than household wealth or socioeconomic status in general. Desai and Alva,<sup>18</sup> and even Frost, Forste, and Haas,<sup>19</sup> note that it is through education that improved, developed healthcare seeking behaviour is achieved through better education level because it sought to change attitudes, traditions, and beliefs. This may also be the colluding factor that in the Visayas area; as also observed in Jejeeboy's and Zeba's,<sup>20</sup> study in different con-



text, autonomy of the mother in deciding to visit health-care facility is found to be positively significant although this has to be studied further regarding its mechanism to it having effect.

The fathers' education levels were curious on this matter in the sense whether it is solely in the Mindanao area that it is found to be statistically significant. Bbaale,<sup>21</sup> notes that for Uganda, a combined better status in terms of education and wealth of both parents are highly important for the immunisation of their child because of the likelihood that the parents have access to white-collar jobs leading to improved access to facilities. Such mechanism is yet to be identified as to how better education level of a father is beneficial in this particular healthcare-seeking behaviour of immunisation of infants in Mindanao.

The rural-urban disparity is often shown to have lacked significance in healthcare seeking practices as observed by Bbaale.<sup>21</sup> They noted that access to healthcare facilities and the supplies itself is predictably lower in rural areas than its counterpart, but as Okunga,<sup>22</sup> and his colleagues, note that this is not observed to be significant for their society in Kenya.

This aspect has to be viewed with more discretion pertaining to the dissolution of disparity between the urban and rural areas. A means to contextualise the rural-urban dichotomy in the context of the Philippines is the devolution of health services. There is a particular level of autonomy granted by the Local Government Code of 1991 to the local-level of governance to determine the needs of the grassroots, but there are issues that arose from the process of devolution.<sup>23</sup> In their assessment from 2003 that procurement of drugs and supplies, general maintenance of facilities, and resignation of key personnel had been the negative outcomes of the process regardless of them being in urban areas or otherwise. It largely depends on external factors, but mostly on the political spectrum. Different elected officials view differently the needs of the people, therefore, the problems being addressed may be varied. In some aspects, immunisation is also affected according to a World Bank report.<sup>24</sup> There is then a sense of disjointedness whereby it is in the official policy of the national level agency as the Ministry of Health to provide all infants with the prescribed inoculation, but there remains a gap to addressing it due to various social and political forces. Such externalities affect the capacity of mothers to realise the completion of the immunisation of their infants depending on which region they reside, also depending on either they are in the rural or urban areas.

Involvement of the woman in the decision-making process to visit a health facility had been observed to be statistically significant in the Visayas region, although it is not observed for infant mortality at the national level

in a previous study.<sup>25</sup> However, for some countries, particularly in a neighbouring Southeast Asian country, it had been observed as such to a higher degree of measurement for infant longevity.<sup>26</sup> The dynamics between husbands and wives may affect the health behaviours of the households. This becomes indicative of what level of care infants receive. Female respondents desire to follow the guidelines by community health facilities; they are unable to follow through because of autonomy issues within the household. This is related to the final factor whereby a seemingly counterintuitive aspect to decrease in likelihood of immunisation adherence is the intentional pregnancy and birth of infant for the Mindanao area sample. As observed in another study with regards to infant mortality rates, those borne of a wanted nature had higher likelihood of dying than those of unintentional circumstance at the national level.<sup>25</sup> This is not a novel observation for the Philippines as Tan,<sup>27</sup> has also observed this based also on a nationally-representative survey sample.

This final note on the literature of the nature of intention of giving birth to an infant is an apt example of the general limitation to this study. To date, there is still a general lack of literature apropos factors found to be statistically significant, regardless of them being positively or negatively associated with the outcome. Few quantitative studies had been performed for infant mortality in the Philippines in the past decades and there are as few when it comes to individual factors pertaining to infant health.<sup>25</sup>

## Conclusion

The factors that may influence the adherence to the prescribed immunisation schedule for infants across the Philippines had been analysed here. The social impact of increasing women's education level had been observed to positively affect preventive healthcare-seeking behaviour in as much as this current study is concerned. It is the factor that is consistent through all three regional areas. A form of disparity ensues further when those with middle or high socioeconomic status have better adherence as well, which is also consistent across regions. Although it is undoubted that this effect of socioeconomic status and women's education is exceptional, an exploration toward reaching those parents or families with less education and less socioeconomic status has to be determined. They are affected in a negative manner if they remain to have non-beneficial healthcare behaviour which tends to retain social inequalities and inequities toward their infants.

The factors utilised in the current study are to be subsumed as dimensions of distal and attitudinal barriers within social determinants of health. The procedure involving both socioeconomic and health factors is novel

in the Philippines context as it has not been keenly utilised based on accessible data. Furthermore, contextualising the figures through qualitative studies is necessary to understand the depth of the issue of the perceived and actual issues experienced by mothers relating to the adherence to immunisation prescription toward the protection of the well-being infants in the Philippines.

## References

1. PrabhuDas M, Adkins B, Gans H, King C, Levy O, Ramilo O, Siegrist C. Challenges in infant immunity: implications for responses to infection and vaccines. *Nature Immunology*. 2011;12(3): 189-94
2. Pollard A, Perrett K, Beverley P. Maintaining protection against invasive bacteria with protein-polysaccharide conjugate vaccines. *Nature Reviews Immunology*. 2009; 9(3): 213–20.
3. Fotso J, Ezech A, Madise N, Ciera J. Progress towards the child mortality millennium development goal in urban sub-Saharan Africa: the dynamics of population growth, immunization, and access to clean water. *BMC Public Health*. 2007; 7: 218.
4. Mondal MN, Hossain MK, Ali MK Factors influencing infant and child mortality: a case study of Rajshahi district, Bangladesh. *Journal of Human Ecology*. 2009; 26 (1): 31-9.
5. Immunization program [Internet]. Department of Health: 2011. Extended program on immunization [updated 2011; cited 2013 Dec 5]. Available from <http://www.doh.gov.ph/node/1067.html>
6. Romualdez A, Rosa JD, Flavie J, Quimbo S, Hartigan-Go K, Lagrada L, David L. The Philippine health system review. *Health System in Transition*. 2011; 1(2).
7. Caballes A. An appraisal of the policy environment for Philippine hospital sector development: USAID-UPECON: 2010. HDP-OP.
8. Becker S, Peters D, Gray R, Gultiano C, Black R. The determinants of use of maternal and child health services in Metro Cebu, the Philippines. *Health Transit Rev*. 1993; 3(1): 77-89.
9. Mosley W, Chen L. An analytical framework for the study of child survival in developing countries. *Population Development Review*. 1984; 10 (Supplement: Child survival: strategies for research): 25-45.
10. Philippine Statistics Authority – National Economic and Development Authority. Philippines – National Demographic and Health Survey 2013. 2017.
11. Balisacan A, Hill Hal. The dynamics of regional development: the Philippines in East Asia. Cheltenham: Edward Elgar; 2007.
12. Knofczynski G, Mundfrom, D. Sample sizes when using multiple linear regression for prediction. *Educational Psychological Measurement*. 2008; 68: 431.
13. Cruz CJ, Vicerra PM. Fertility behavior, desired number and gender composition of children: the Philippine case. Paper presented at: 2013 PPA. Proceedings of the 2013 Population Association of America Conference; 2013 Apr 11-13; New Orleans, United States of America.
14. Singh A, Pallikadavath S, Ogollah R, Stone W. Maternal tetanus toxoid vaccination and neonatal mortality in rural north India." *PLOS One* 7(11) [Internet] 2012 [Cited 2016 Dec 6]; Available from: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0048891>
15. Basu AM, Stephenson R. Low levels of maternal education and the proximate determinants of childhood mortality: a little learning is not a dangerous thing. *Social, Science and Medicine*. 2005; 60:2011-23.
16. Kravdal Ø. Child mortality in India: the community-level effect of education. *Population Studies*. 2004; 58 (2): 177-92.
17. Pamuk E, Fuchs R, Lutz W. Comparing relative effects of education and economic resources on infant mortality in developing countries." *Population and Development Review*. 2011; 37(4): 637-664.
18. Desai S, Alva S. Maternal education and child health: is there a strong causal relationship? *Demography*. 1998; 35: 71-81.
19. Frost MB, Forste R, Haas DW. Maternal education and child nutritional status in Bolivia: finding the links. *Social, Science and Medicine*. 2005; 60:395-407.
20. Jejeebhoy S, Zeba S. Women's autonomy in India and Pakistan: the influence of religion and region. *Population Development Review*. 2011; 27:687-712.
21. Bbaale E. Factors influencing childhood immunization in Uganda. *Journal Health Population and Nutrition*. 2013; 1:118-29.
22. Okunga W, Amwayi A, Kutima L. Determinants of childhood vaccination completion at a peri-urban hospital in Kenya, December 2013 - January 2014: a case control study. *The Pan African Medical Journal*. 20 [Internet] 2015 [cited 2017 May 4] Accessed from doi:10.11604/pamj.2015.20.277.5664
23. Grundy J, Healy V, Gorgolon L, Sandig E. Overview of devolution of health services in the Philippines. *Rural and Remote Health*. 2003; 3(2).220 [Internet] 2003 [cited 2017 May 4] Available from: [http://www.rrh.org.au/publishedarticles/article\\_print\\_220.pdf](http://www.rrh.org.au/publishedarticles/article_print_220.pdf)
24. Lieberman SS. Decentralization and health in the Philippines and Indonesia: an interim report. 2002: World Bank - East Asia and Pacific Region.
25. Vicerra PMM. Proximate determinants of infant mortality in the Philippines 2003 - 2008 [Thesis]. Thailand: Chulalongkorn University; 2014.
26. Stiyaningsih H, Wicaksono F. Impact of women's empowerment on infant mortality in Indonesia. *Kesmas: National Public Health Journal*. 2017; 11(4): 185-91.
27. Tan C. Unwanted fertility and the underinvestment hypothesis: a Philippine study [PhD thesis]. Virginia: Virginia Polytechnic Institute and State University; 1981.