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| RESEARCH ARTICLE

Selected Non-Price Factors and its Effects to Children's Immunization Coverage in Pandacan, Philippines

Mariel Anne M. Agsalud[1], Raziela Thea SD. Evangelista[2], Maria Ranja Victoria M. Porrras[3] ✉ and Asst. Prof. Ronald B. Paguta, MAE[4]

[1234]Business Economics Department, College of Commerce and Business Administration, University of Santo Tomas, Philippines

Corresponding Author: Maria Ranja Victoria M. Porras, **E-mail**: mariaranja.porras.comm@ust.edu.ph

| ABSTRACT

Since 2008, the Philippines has been facing a continuous decline in its immunization rate for vaccine-preventable diseases leading to the re-emergence of polio cases and a nationwide measles outbreak. In 2017, more than half of the entire child population did not receive the complete set of vaccines. This study addressed this issue by discussing selected non-price factors that may affect immunization coverage of children, specifically, parental/caregiver vaccine literacy, the distance of the household's residence to a health facility, and the household size. This research used data from the survey questionnaires that were answered by parents or caregivers with children aged above one to five residing in Barangay 845, Pandacan, Manila. Multiple logistic regression was applied to analyze the data, and it was determined that parental/caregiver vaccine literacy and household size are significant factors that affect immunization coverage of children. However, the distance of the household's residence to a health facility was found to be insignificant to a child's immunization coverage.

| KEYWORDS

Immunization Coverage, Expanded Program on Immunization, Vaccine-Preventable Diseases, Parental Vaccine Literacy, Distance, Household Size

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1. Introduction

Immunization is proven to be an effective, low-cost public health intervention that prevents infectious disease outbreaks and an important goal to achieve the global health objective, which is to improve people's health (WHO, 2021). Attaining full immunization coverage for children is one of the global initiatives of the World Health Organization (WHO), which led to the onset of the Expanded Program on Immunization (EPI) in 1974. The EPI has made headways in lowering morbidity and mortality from vaccine-preventable diseases (VPDs); however, children receiving vaccination are still declining (WHO, 2021).

The Republic of the Philippines, working in unison with WHO, implemented EPI in 1976. It is one of the chief programs of the Department of Health (DOH) for public health, which aims to guarantee that infants/children and mothers have access to routinely recommended infant/childhood vaccines. To further strengthen the program, Republic Act No. 10152 (R.A. No. 10152) was enacted in 2011 (DOH, 2021). It indicated that the mandatory basic immunization for all infants and children should cover the following vaccine-preventable diseases: tuberculosis, diphtheria, tetanus and pertussis, poliomyelitis, measles, mumps, rubella or German measles, hepatitis-B and H. Influenza type B (HIB). This also mandated that basic immunization for the aforementioned VPDs must be provided free of charge at any government hospital or health center to infants and children under five years old (DOH, 2021).

Over the years, the Philippines' EPI has evinced its success in reducing morbidity and mortality rate. The country declared zero polio cases in 2000, and in 2017, it successfully eliminated maternal and neonatal tetanus. Even with this undeniable development, the country has been confronted by fluctuating figures on its immunization rate since 2008 till the present date. The targeted 95% immunization coverage was never achieved, and few cases of polio occurred again in 2019. The rate of children with complete basic vaccination was at 79.5% in 2008, 76.5% in 2013, and decreased to 69.9% in 2017. The country's fully immunized children (FIC) were only at 48.4%, and one out of five children was not able to receive measles vaccines, as well as 21% had not received polio vaccine in 2017. Moreover, children with complete basic vaccines across the majority of the regions were at 50 to 75% at best, and only 10.6% were able to complete their vaccines on time. It is also evident that lower immunization is prevalent on later doses of vaccines. According to Philippine Statistics Authority (PSA), 1 out of 2 children missed their second dose of measles vaccine, and 3.9% and 5.8% of children have not completed their second and third dose of OPV vaccine, respectively. A similar trend was observed with the Pentavalent vaccine (PSA, 2017; PIDS, 2020).

Furthermore, the Philippines, along with Nigeria, India, the Democratic Republic of the Congo (DRC), Pakistan, Ethiopia, Brazil, Indonesia, Angola, and Mexico, accounted for approximately 65% of zero-dose children in 2019 (CDC, 2019). Unlike most of the Philippines' neighbouring countries in the ASEAN, which had success in the increase and maintenance of high immunization coverage, the Philippines showed considerable fluctuations and failed to maintain its past gains (PIDS, 2021). It was also reported that the Philippines experienced a sharp drop from 87% immunization coverage last 2014 to 68% in 2018. This plunge makes children more susceptible to VPDs such as polio and measles. This is evidenced by the measles outbreak, which saw a 130% increase in cases compared to the same period in 2018 and the polio re-emergence in the Philippines with 17 confirmed cases, which occurred last 2019 (UNICEF, 2019). The 2019 measles outbreak in the Philippines is attributed to the decline in the first dose of the measles vaccine in the past decade. Figures exhibited a decline from above 80% in 2008 to below 70% in 2017, and estimations for 2018 show further reduction (WHO, 2019). On the other hand, the Office for the Coordination of Humanitarian Affairs has cited the WHO and UNICEF in their 2019 press release that 66% of Filipino children were able to complete their oral polio vaccine (OPV) doses, and 45% received their inactivated polio vaccine (IPV). It is for this reason that children become more vulnerable to polio. This shows that even though the Philippine EPI has shown remarkable progress since its inception, it still has a long way to go in attaining full immunization coverage for children.

Due to the significant importance of immunization, this study was conceptualized. The authors identified the selected non-price determinants of demand and their impact on immunization coverage on children. Although several studies attempted to identify the impact of the non-price determinants of demand to immunization coverage, only a few studies were done in the Philippines. This paper discussed the relationship of parental/caregiver vaccine literacy, the distance of their residence to health facilities, household size, and immunization coverage of children aged above one until five in Barangay 845, Pandacan, Manila.

The findings of this study aimed to provide critical inputs to explain the trend of immunization coverage of children in Barangay 845, Pandacan, Manila. Additionally, it will provide important information that can help the local government unit further improve their strategies in administering vaccines to children and, therefore, help reach the national target of having all children fully immunized by 2030.

2. Literature Review

2.1 Immunization Coverage

The definition of fully immunized children (FIC) varies by country. The WHO developed a guideline which states that a child is fully immunized when he or she receives one dose of BCG, three doses of DPT, one dose of measles vaccination, and three doses of OPV within his or her 12 to 23 months of age (Vohra et al., 2013; Tamirat & Sisay, 2019). The Philippines and Malawi modified this guideline, added three doses of HepB and limited the recommended age to before reaching one-year-old (Munthali, 2007; Raguindin et al., 2021). Vohra (2013) also defined partially immunized children as those who failed to receive some of the vaccines, while not immunized children are those who have not received any vaccine. Multiple studies also observed the importance of vaccines' timeliness of administration, i.e., doses should be taken as per recommended schedules (Raguindin, 2021; Kiely et al., 2018).

Below is the national immunization schedule adopted from the Philippine Institute for Development Studies (2019).

Table 1. Philippine national immunization schedule for children 0 to 12 months of age

Vaccine / Antigen	Disease	Doses	Schedule
BCG (Bacillus Calmette–Guerin)	Tuberculosis	1	Birth (within 24 hours)
HepB	Hepatitis B	1	Birth (within 24 hours)
Pentavalent vaccine (DPT-HepB -HiB)	Diphtheria, tetanus, and pertussis Hepatitis B Hemophilus influenzae type B Meningitis	3	6 weeks, 10 weeks, 14 weeks
OPV (Oral polio vaccine)	Poliomyelitis	3	6 weeks, 10 weeks, 14 weeks
IPV (Inactivated polio vaccine)		1	14 weeks
PCV (Pneumococcal conjugate vaccine)	Pneumococcal infections (e.g. meningitis)	3	6 weeks, 10 weeks, 14 weeks
MCV (Measles containing vaccine) and MMR (Measles, Mumps, rubella)	Measles, mumps, rubella	2	9 months, 1 year

Source: Philippine Foundation for Vaccination

Despite the success of the administration of national immunization programs, the recent appearance of disease outbreaks in ASEAN cities such as Yangon, Manila, and Hanoi brought doubt on the effectiveness of such programs in urban areas. Evidence shows that immunization coverage in urban areas was underestimated. In Cambodia, Indonesia, and the Philippines, there is no clear strategy for the improvement of urban health. Though there are initiatives that innovate immunization strategies in urban settings, it is hindered by challenges in terms of strategic legal, policy, and planning (UNICEF, n.d.).

2.2 Vaccine Literacy

Various researches have been made to exhibit the association between vaccine literacy and its effect on childhood morbidity and mortality in terms of full immunization coverage.

In studies conducted in Africa, maternal knowledge, specifically knowledge on vaccines, was established to have a positive relationship with complete immunization coverage. The results of Dechasa and Legesse (2015) studies on the determinants of child immunization coverage in Southeast Ethiopia and Vonasek et al. (2016) on the correlation of complete childhood immunization and maternal knowledge in rural Uganda are conclusive with each other. Children are more likely to be fully immunized when their mothers have sufficient knowledge of vaccines and VPDs (Dechasa and Legesse, 2015) and could accurately state that childhood immunizations protect children from diseases (Vonasek et al., 2016).

Additionally, a study in rural Nigeria by Odusanya et al. (2008) showed that there is a significant correlation between maternal knowledge and vaccination and full vaccination. Odusanya et al. (2008) study showed that mothers who participated in the survey had high and generally positive knowledge and attitudes. A similar study was done by Lakew et al. (2015) on the factors influencing full immunization among children in Ethiopia, which found that increased knowledge of mothers in health education may lead to full immunization coverage.

Other studies included maternal literacy knowledge as one of the determinants in identifying factors affecting full immunization coverage and considered both parents' knowledge on vaccines. Parents who have a good perception of vaccination's benefits and risks lead to children's complete immunization (Quitaba B Al-lela et al., 2014).

Other studies evaluating immunization coverage showed that lack of information regarding vaccine benefits and risks was a factor for non-vaccination. Kamau and Esamai (2001) study established that the factors responsible for low immunization coverage include low educational attainment and relatively insufficient knowledge on immunization. Among the results of the study was that knowledge on immunization has a significant influence on the immunization of the child. Similar research was done by Phukan et al. (2009) in India, which revealed that the main reason for non-immunization was a lack of information among parents. Zida-Compaore et al. (2019) discussed in their study that 96% of the respondents did not know the number of vaccines children must receive, while nearly 62.9% were unaware of the number of required immunization sessions. This stems from the problem of lack of information on vaccine benefits and risks. The study of Sheikh et al. (2013) determined that lack of knowledge is the most frequent and main reason for not achieving full immunization coverage in Pakistan, followed by a busy schedule which led to lack of time. The insufficient knowledge took into account illiteracy, lack of awareness, and misconceptions.

H1: Higher parental/caregiver knowledge on vaccines and their corresponding dosages, schedule, benefits, and risks would lead to their children having full immunization coverage.

2.3 Distance to Health Facilities

Access to health services may come in several forms (Evans, Hsu & Boerma, 2013). In this study, immunization is assumed to be affordable because the vaccines under EPI are offered free of charge for children under five years old; hence, financial affordability is no longer taken into account. Physical accessibility was given more consideration in this study as acceptability is already under the domain of vaccine literacy.

Several studies conducted in Africa show that distance to the nearest health center has a significant relationship with immunization coverage. In the study of Okwaraji et al. (2012), travel time is correlated with BCG and Measles vaccine coverage of children in rural Ethiopia. This study also found that it is less likely for children to receive Penta3 vaccines when they live 60 or more minutes away from the health post, compared to those who live less than 30 minutes away. The study of Kiptoo et al. (2015) reported similar results wherein children who live closer to the health facility are more likely to have full vaccination compared to those who walk for an hour or more. Such findings were conclusive to the results of the study of Ibnouf et al. (2014), which revealed that children are more likely to have the correct vaccinations when their mothers have a walking time of 30 minutes or less to the nearest vaccination area compared to those whose mothers spent 30 minutes or longer.

Similar results were seen in Ekouevi et al. (2018) study, which showed the association of distance to incomplete immunization coverage. It is more likely for children whose parents had to walk for more than half an hour to the health center to have incomplete immunization coverage.

Studies that were done in Asia also showed that distance in terms of walking time is a factor that affects the immunization status of children (Adhikary et al., 2013). Similarly, the study of Amin et al. (2013) showed impediments to children's complete immunization, including geography and walking distance.

However, the study of Nawaz et al. (2014) found that there is no statistical significance between immunization status and distance from the immunization center. The study of Dechasa and Legesse (2015) also contradicted the results of the previous studies mentioned, as its findings showed that children whose mothers or caregivers with less travel time are less likely to be fully vaccinated.

Sanou et al. (2009) highlighted that children living in the boundaries of a village in Burkina Faso had the same immunization coverage rate as children living closer to the vaccination site. Poorolajal (2012) reported that in Hamadan Province of west Iran, distance from the nearest health care did not correlate with delayed immunization. Additionally, the majority of mothers perceived that distance of the health facility is not a problem in attaining full immunization coverage and showed no significant association in the adjusted logistic regression model (Sarker, 2019). A unique study conducted by Ekouevi et al. (2018) reported that the barriers to full immunization coverage are long distance to the health center, poor road condition, lack of transportation, and time insufficiency.

Distance to healthcare facilities may play a role in the number of fully vaccinated children; the farther the location of the health facility, the bigger the chances of children not being vaccinated. The distance may not only be the factor, but road conditions and modes of transportation can also influence the decision of parents to have their children fully immunized. Thus, the second hypothesis for this study is:

H2: Families living farther from a health facility would not result in the children having complete immunization coverage.

2.4 Household Size

Several studies presented sociodemographic factors as determinants of immunization coverage, which includes household size.

One of the significant factors associated with the low vaccination rate of children in Nigeria is the number of children in the family. This was similar to one of Kiptoo et al. (2015) findings, wherein a possible determinant of full immunization is the number of siblings in the household. Families with less than three children have a higher probability of being fully immunized than families with more than four children. The researchers have determined that family size is significantly associated with full immunization. Children who belong to a larger family size have low vaccine uptake than those who belong to a smaller family size (Kiptoo et al., 2015). According to Awadh et al. (2015), larger family size and low educated parents were related to the age-appropriate immunization status of children.

To further support the association of household size and immunization coverage, Girmay and Dadi (2019) observed that having five and more members of the family are less likely to get vaccinated. Oliveira et al. (2014) analysis on the factors of complete immunization coverage found that besides other factors, the immunization rate greatly differed according to family size. Similarly, Sarker et al. (2019) analyzed the 2017 Continuous Senegal Demographic and Health Survey; it was found that children with smaller family sizes, having less than four members, have greater immunization coverage than those who have larger family size. In Indonesia, Herliana and Douiri (2017) had similar findings that there was a lower immunization coverage among children who belong to larger family sizes.

On the other hand, in Pakistan, Noh et al. (2018) discovered that the number of living children was among other determinants associated with the successful completion of basic immunization. Noh et al. (2018) perceived that more parents learn more about immunization and observance of the schedule due to recurrence from their previous child. Additionally, Nozaki et al. (2019) contradicted the aforementioned studies' results. The results gathered from their study were not enough to conclude that there is a faintly higher immunization coverage among households with a single child compared to those with two or more children despite the observations.

Household size may have an impact on a fully vaccinated child. As family size grows bigger, studies revealed that there was a greater chance of not being fully vaccinated. It was not made clear if the household size might be influenced by parents having less time on attending to the vaccination schedule due to busy schedules or any related reason that may be associated with household size. Overall, the majority of the studies have concurring results. Hypothesis for household size and immunization coverage of children was derived from the studies presented above. The hypothesis is as follows:

H3: Having a larger household size would not lead to the children having complete immunization coverage.

3. Methodology

3.1 Research Design

This study used a quantitative research approach to evaluate the impact of non-price factors on the immunization coverage of children on vaccines under the EPI in Barangay 845, Pandacan, Manila. Moreover, a cross-sectional study has been employed as the study only focused on a particular sample population.

This study has worked on primary data gathered from the responses of the survey questionnaire, which contained questions that assessed the parent's or caregiver's vaccine literacy, the distance of their residence to the barangay's health center (walking time in minutes), and the household's size (number of children living in the household's residence). The researchers have adopted the surveys from similar studies (Dechasa & Legesse, 2015; Sheikh et al., 2013; Phukan et al., 2009) and modified the questions according to the specific characteristics that this particular study would entail. The survey questionnaires have close-ended questions wherein respondents choose their answers from the given ranges. In the case of questions on vaccine literacy, participants have to choose the correct answer. Questions and responses regarding vaccine literacy have been validated by a physician. Consequently, responses for all variables were tallied and analyzed. For the demographic profile of the respondents (parents or caregivers) and the immunization profile of the children, the respondents were asked to provide their answers. These were arranged by the researchers in corresponding ranges. In consideration to those mothers or caregivers not well-versed in the English language, questions from the survey questionnaire employed the usage of Tagalog as its language.

3.2 Data and Sources

The participants of this study were composed of parents who have children aged above one to five residing in Barangay 845, Pandacan, Manila. The parent or caregivers who are included in the target participants were those who mainly oversee their children's healthcare. This pertained to those who consistently monitor infants' booklets and have the best recall on their children's vaccination.

The rationale behind the age inclusion was that children in the age group identified were expected to have completed all doses of the vaccines. The PSA defined fully immunized children as infants who received one dose of BCG, three doses each of OPV, DPT, and Hepatitis B vaccines, and one dose of measles vaccine before reaching one year of age. Another point to consider was that the recommended age for administering the vaccine does not exceed one year. The schedule should be adhered to because a delayed vaccination will make the child unprotected from the VPDs at a time when they are most vulnerable, and it will also increase the risk of the child acquiring such disease (Raguindin, P.F. et al., 2021). These criteria were set to determine whether children eligible for free vaccination can complete the recommended doses of the vaccines before they turn one-year-old. On the other hand, infants were excluded in this study for they are still in the middle of immunization. Children above five years old were also excluded because the mandatory basic immunization given for free at any government hospital or health center is only given to infants and children up to five years of age.

The researchers selected participants through a population census. The study focused on households with children aged above one to five years old. According to the barangay office of the selected study site, there are 122 households with children at the age bracket of above one until five years old. However, only 74 of the households agreed to be part of the study, with a total of 105 children qualified for the inclusion criteria.

This study focused on an urban area because, despite its modernization and easy access to health facilities, several families are still not aware of the benefits of the vaccines. The City of Manila, a highly urbanized city, was the target location of the study, while Pandacan, Manila, was the focus and sub-location of this study. Pandacan is the sixth most occupied district in Manila, which comprises 38 barangays (Philippine Atlas, 2015). The researchers selected Barangay 845 as the study site since the barangay chairman gave consent to conduct the study in their area. One of the said barangay officials offered assistance in carrying out the census survey. The Bagong Barangay Lying-In Center offers vaccines under EPI free of charge and caters to several barangays in Pandacan, including Barangay 845.

3.3 Mode of Analysis

Descriptive statistics were used to represent the background characteristics of each participant, as well as the immunization coverage of the children. Moreover, the regression model which was employed in this study was derived from the literature review presented in the previous chapter. The regression model is as follows:

$$I = B_0 + B_1 VL + B_2 Dist + B_3 HS + e$$

Where I is a measure of immunization coverage, B_0 represents the intercept, B_1, B_2 and B_3 correspond to the coefficient of each independent variable. VL represents parental/caregiver vaccine literacy, $Dist$ represents the distance to a health facility, and HS represents the household size. Lastly, e corresponds to the error term.

A bivariate analysis will be done to know the significant variables to immunization coverage. Below are the specific statistical methods that will be employed in the study:

a) Chi-square test of independence
A chi-square test of independence was used to establish the association of the explanatory variables to the immunization coverage. This method is suited for categorical independent variables with a binomial outcome variable.

The linear-by-linear association chi-square test was employed to determine whether there is a linear relationship between the null and alternative hypotheses. The standard level of significance was applied in this test. If the p-value of the explanatory variables is less than the alpha level at 0.05 p-value, it means that there is no linear relationship between the null and alternative hypotheses. It also indicates that the explanatory variables are significant, and it affects the dependent variable.

b) Mean Square Contingency Coefficient
To substantiate the results of the chi-square of independence, the Mean Square Contingency Coefficient (Phi Coefficient), an association test that determines the degree of relationship between two binary variables, was necessarily utilized.

Consequently, significant variables will then be applied to logistic regression analysis. According to Peng et al. (2002), logistic regression is generally appropriate to use for describing and testing hypotheses about relationships between a binary categorical outcome variable and one or more categorical or continuous predictor variables. In this study, immunization coverage is a categorical dependent variable that will be classified into full and no immunization. Meanwhile, vaccine literacy can be classified as high and low, following the physician's rating on the survey questionnaire. The distance to a health facility will be categorized as near or far depending on the minutes spent walking from the household's residence to the health facility. Moreover, household size will be categorized into small or large based on the number of children living within a household.

Under logistic regression, the Omnibus Tests of Model Coefficient is a statistical test similar to the F-test. It examines the overall significance of the explanatory variables in the regression equation. It advises whether the variables fit in the model or not. Additionally, Nagelkerke R square or the coefficient of determination was computed to know how much of the immunization coverage was affected by the independent variables.

The following operational definitions were used for each variable of the study.

Distance to a health facility: Specifically, for this study, it would be measured by the minutes spent walking from the household's residence to a health facility. Families who spent 15 minutes or more on walking time will fall under the far category, and those who walk for less than 15 minutes will be categorized as families living near the health center.

Full/Complete immunization: For this study, vaccines included in Table 1 would be the basis for full immunization coverage of children.

No immunization: A child who had not received any vaccine by 12 months of age is categorized as having no immunization (Ekouevi et al., 2018).

Household size: In this present study, the number of children will be the measurement of this variable. Families with three children and more will be considered as large household size, while those with less than three children will be classified as small household size.

Parental/Caregiver vaccine literacy: Vaccine literacy is defined as having knowledge on vaccines and developing a system with less perplexity to convey and offer vaccines as essential in an operating health system (Ratzan, 2011). In this study, the vaccine literacy of the parent/s or caregiver will be evaluated.

4. Results and Discussion

For the measurement of vaccine literacy, the respondents answered a 22-item questionnaire which consisted of sections about general knowledge, effects, misconceptions, and benefits of vaccines, EPI, and timely vaccination. In this research, the following criteria were used to determine the categories of responses: The responses will be rated with high literacy, which is equivalent to 75% and above if the respondent scored 16 or more points on the questionnaire. On the other hand, scores below 16 will be rated as low literacy, which corresponds to below 75%.

For the household size, families with three and more children were considered as large households. As for the distance to the health facility, those who walked for more than 15 minutes to the health center were categorized as families living far from the vaccination site. Furthermore, barriers to full immunization were analyzed as well so that the Barangay 845 officials could use this as a reference on how to implement the EPI more effectively.

Multiple logistic regression was used to determine the likelihood of children having complete vaccination based on their parents' vaccine literacy, household size, and distance to the health facility. The baseline regression model contains all independent variables regardless of their association with immunization coverage. A new multiple regression equation was proposed, which only included significant variables that affect immunization coverage. The new regression equation was tested through the Omnibus Test of Model Coefficient to see if the significant variables fit in the model.

The researchers garnered 74 respondents from the survey questionnaire. Out of the 74 respondents, 5.41% were less than 18 years of age, 64.86% were 18 – 35 years of age, 24.32% were 36 – 55 years of age, and 5.41% were more than 56 years of age. Moreover, 58.11% were female among the respondents, while 41.89% were male.

In terms of the respondent's educational attainment, the majority of them only finished high school with 81.08%. Respondents who finished college and elementary were not far from each other with 9.46% and 6.76%, respectively. On the other hand, those who finished technical/nontechnical vocation courses comprised 2.70% of the respondents. In addition, 79.73% of the respondents have a nuclear family structure, followed by an extended family structure with 12.16%. Furthermore, 6.76% were single parents, and 1.35% were grandparents.

Table 2. Demographic Characteristic of the Respondents

Demographic Characteristic	Category	Count	%
Age	<18	4	5.41%
	18 – 35	48	64.86%
	36 – 55	18	24.32%
	56>	4	5.41%
		43	58.11%
Sex	Female		
	Male	31	41.89%
		5	6.76%
Educational Attainment	Elementary		
	High School	60	81.08%
	College	7	9.46%
	Technical/Nontechnical vocation	2	2.70%
Family Structure	Single Parent	5	6.76%
	Nuclear	59	79.73%
	Extended	9	12.16%
	Grandparent	1	1.35%

A total of 105 children were reported from the 74 households that responded to the survey. Among the 105 children, 54 (51.43%) only have complete immunization (i.e., the correct number of dosages of BCG, HepB, DPT-HepB-HiB, OPV, IPV, PCV, and MMR), while 51 (48.57%) has incomplete immunization. Those with incomplete immunization were further categorized as those who had correct dosage/s from the particular vaccine, with incorrect or incomplete dosages from the particular vaccine, and those who were not immunized from the particular vaccine at all. Table 3 specifies which vaccines were lacking from the children with incomplete immunization, while Figure 1 compares the immunization coverage of the children.

Figure 2 shows the reasons provided by the parent or caregiver as to why their child has incomplete immunization. Only two reasons were perceived from the responses, with the majority (71%) stating that they lack time to bring their child to the vaccination site. The rest (29%) stated that the vaccine was not available during their time of visit to the vaccination site.

Table 3. Summary of Immunization Coverage

Immunization Coverage	BCG	HepB	DPT-HepB-HiB	OPV	IPV	PCV	MMR
Complete Immunization	54	54	54	54	54	54	54
Incomplete Immunization *(Correct Dosages)*	50	48	39	42	43	33	4
Incomplete Immunization *(Incorrect Dosages)*	0	0	9	6	4	14	44
Incomplete Immunization *(No Immunization)*	1	3	3	3	4	4	3
Total Count	105	105	105	105	105	105	105

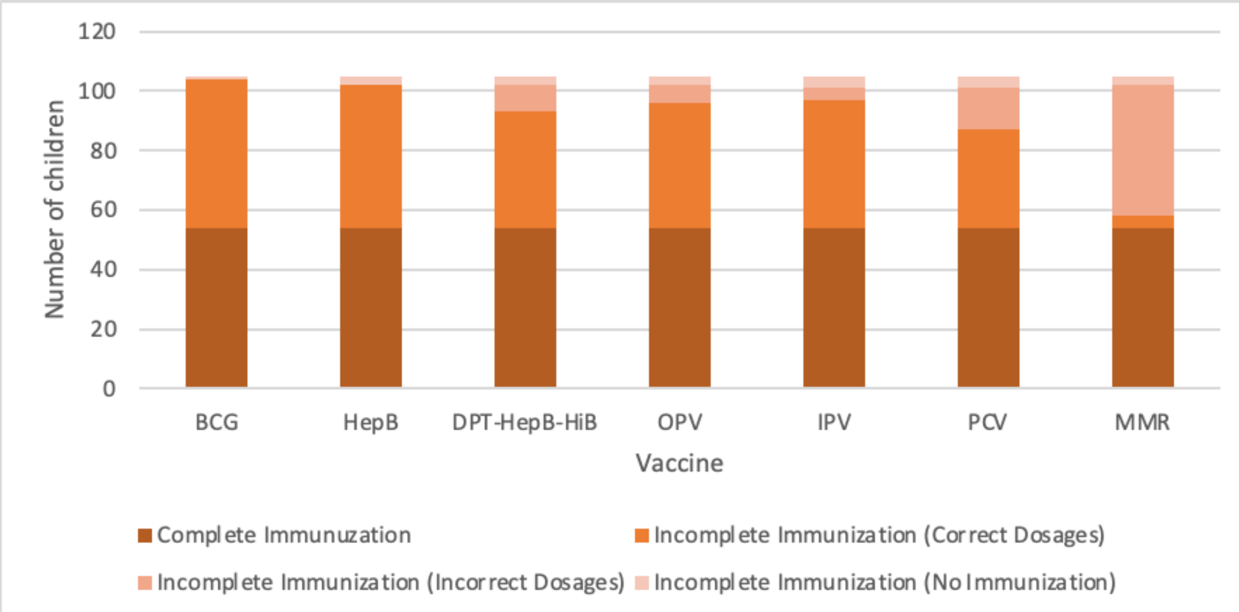

Figure 2. Immunization Coverage

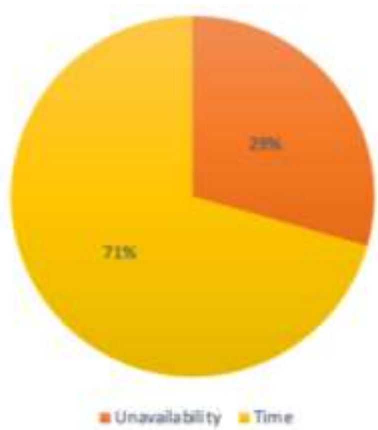

Figure 3. Reasons for Incomplete Immunization

The vaccine literacy of the parents and caregiver was assessed through a series of questions composed of general knowledge, vaccination effects and benefits, misconceptions on vaccination, and information on EPI and timely vaccination. All of the respondents answered correctly on the vaccination benefits, 67 (90.54%) were informed of the correct and timely vaccination schedule, 55 (74.32%) were aware of the common misconceptions on vaccines are false, 30 (40.54%) were informed of the EPI coverage, 23 (31.08%) have a general knowledge on vaccines, and 11 (14.86%) knows the effects of vaccination.

Table 4. Summary of Vaccine Literacy Scores

Score	General Knowledge	Effects	Misconceptions	Benefits	EPI	Timely Vaccination
100%	23	11	55	74	30	67
≥ 90%, < 100%	0	0	0	0	0	0
≥ 80%, < 90%	0	48	0	0	0	0

≥ 70%, < 80%	3	0	13	0	0	0
≥ 60%, < 70%	0	11	0	0	42	3
≥ 50%, < 60%	44	0	6	0	0	0
< 50%	4	4	0	0	2	4
Total Count	74	74	74	74	74	74

Among the respondents, 59 (79.73%) stated that their place of residence is near the vaccination site (i.e., distance in terms of minutes walked is 15 minutes or less), while 15 (20.27%) stated the contrary.

Table 5. Summary of Distance of Place of Residence to Vaccination Site

Distance	**Count**	**Percentage**
Near	59	79.73
Far	15	20.27
Total Count	74	100

With respect to the household size, 58 (78.38%) households are categorized as small, while 16 (21.62%) are categorized as large.

Table 6. Summary of Household Size Categorization

Household Size	**Count**	**Percentage**
Small	58	78.38
Large	16	21.62
Total Count	74	100

4.1 Chi-Square Test of Independence

A cross-tabulation was done to see the trend of the relationship between the dependent variable and the independent variables. In Table 7, cross-tabulation was done between immunization coverage and vaccine literacy. With the results, it was found that 59.3% of the respondents with high vaccine literacy have complete immunization while 40.7% have incomplete immunization. On the other hand, 100% of the respondents who have low vaccine literacy fell under incomplete immunization.

Table 7. Cross-tabulation between Immunization Coverage and Vaccine Literacy

			VACCINE LITERACY		Total
			Low	High	
IMMUNIZATION COVERAGE	Complete Immunization	Count	0	54	54
		% within VACCINE LITERACY	0.0%	59.3%	51.4%
	Incomplete Immunization	Count	14	37	51
		% within VACCINE LITERACY	100.0%	40.7%	48.6%
Total		Count	14	91	105
		% within VACCINE LITERACY	100.0%	100.0%	100.0%

A chi-square test of independence was done to further prove the relationship between immunization coverage and vaccine literacy. Table 8 showed a computed chi-square value of 16.941 with a p-value of 0.000. Since the p-value is less than the alpha at 0.05 level of significance, the relationship between immunization coverage and vaccine literacy is significant; thus, vaccine literacy is significantly influential to the immunization of children. Furthermore, the Phi coefficient, which has a value of 0.404, showed that immunization coverage and vaccine literacy constitutes a moderate association.

Table 8. Chi-Square Tests between Immunization Coverage and Vaccine Literacy

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.104[a]	1	.000		
Continuity Correction[b]	14.811	1	.000		
Likelihood Ratio	22.517	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	16.941	1	.000		
N of Valid Cases	105				

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.404	.000
	Cramer's V	.404	.000
N of Valid Cases		105	

In Table 9, cross-tabulation was done between immunization coverage and distance. With the results, it was found that 63.6% of the respondents with a far distance from the health facility have complete immunization while 36.4% have incomplete immunization. On the other hand, 51.8% of the respondents with near distance from the health facility fell under incomplete immunization, while 48.2% have complete immunization. A chi-square test of independence was done to further prove the relationship between immunization coverage and distance.

Table 9. Crosstab between Immunization Coverage and Distance

			DISTANCE		Total
			Near	Far	
IMMUNIZATION COVERAGE	Complete Immunization	Count	40	14	54
		% within DISTANCE	48.2%	63.6%	51.4%
	Incomplete Immunization	Count	43	8	51
		% within DISTANCE	51.8%	36.4%	48.6%
Total		Count	83	22	105
		% within DISTANCE	100.0%	100.0%	100.0%

Table 10 showed a computed chi-square value of 1.645 with a p-value of 0.200. Since the value of the p-value is greater than the alpha at 0.05 level of significance, the relationship between immunization coverage and distance is found to be insignificant; thus, distance is not influential to the immunization of children.

Table 10. Chi-Square Tests between Immunization Coverage and Distance

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.660[a]	1	.198		
Continuity Correction[b]	1.100	1	.294		
Likelihood Ratio	1.680	1	.195		
Fisher's Exact Test				.235	.147
Linear-by-Linear Association	1.645	1	.200		
N of Valid Cases	105				

In Table 11, cross-tabulation was done between immunization coverage and household size. The results found that 75% of the respondents with large household sizes have complete immunization while 25% have incomplete immunization. On the other hand, 54.1% of the respondents who have small household sizes fell under incomplete immunization, while 45.9% have complete immunization. A chi-square test of independence was done to further prove the relationship between immunization coverage and household size.

Table 11. Crosstab between Immunization Coverage and Household Size

			HOUSEHOLD SIZE		Total
			Small	Large	
IMMUNIZATION COVERAGE	Complete Immunization	Count	39	15	54
		% within HOUSEHOLD SIZE	45.9%	75.0%	51.4%
	Incomplete Immunization	Count	46	5	51
		% within HOUSEHOLD SIZE	54.1%	25.0%	48.6%
Total		Count	85	20	105
		% within HOUSEHOLD SIZE	100.0%	100.0%	100.0%

Table 12 showed a computed chi-square value of 5.443 with a p-value of 0.020. Since the p-value is less than the alpha at 0.05 level of significance, the relationship between immunization coverage and household size is found to be significant; thus, household size is significantly influential to the immunization of children. Furthermore, the Phi coefficient, which has a value of 0.229, showed that immunization coverage and household size constitute a low association.

Table 12. Chi-Square Tests between Immunization Coverage and Household Size

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.495[a]	1	.019		
Continuity Correction[b]	4.391	1	.036		
Likelihood Ratio	5.724	1	.017		
Fisher's Exact Test				.025	.017
Linear-by-Linear Association	5.443	1	.020		
N of Valid Cases	105				

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.229	.019
	Cramer's V	.229	.019
N of Valid Cases		105	

4.2 Multiple Logistic Regression

Since the distance to the health facility was deemed as an insignificant variable from the chi-square test of independence, it was no longer included in the multiple logistic regression. Therefore, only the vaccine literacy, household size, and immunization coverage proceeded to the regression analysis. Due to this, a new regression equation was formed. The new model is as follows:

$$I = B_0 + B_1VL + B_3HS + e$$

Table 13. Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	105	100.0
	Missing Cases	0	.0
	Total	105	100.0
Unselected Cases		0	.0
Total		105	100.0

The first test performed in the regression analysis was the case processing. Table 13 showed that all 105 respondents were included in the analysis, and there was no missing case. This meant that all participants answered the survey completely and correctly.

For the following statistical tests, the standard level of significance with a p-value of 0.05 was used as the alpha level.

Table 14. Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.508	3	.000
	Block	40.508	3	.000
	Model	40.508	3	.000

In the Omnibus Tests of Model Coefficient, the table showed that the p values of step, block, and model tests were at 0.000, which is less than the alpha level. It meant that the parental vaccine literacy and household size had an overall significance to the immunization coverage of children.

Table 15. Model Summary

Step	-2 Log likelihood	Cx & Snell R Square	Nagelkerke R Square
1	104.967[a]	.320	.427

Nagelkerke R square was employed to calculate the coefficient of determination of the regression model. The result showed that 42.7% of the variability in the immunization coverage was brought about by the combined effect of parental vaccine literacy and household size.

The next test conducted was the multiple regression analysis. This test predicted the probability of having incomplete immunization based on parental vaccine literacy and household size. It highlighted the significance of the variables separately and measured which category had the most chance to experience having incomplete immunization.

Table 16. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	h_size(1)	1.583	.681	5.409	1	.020	4.869	1.283	18.480
	distance(1)	.123	.678	.033	1	.856	1.131	.300	4.267
	vacclit_score	-.180	.041	19.351	1	.000	.835	.771	.905
	Constant	13.634	3.436	15.748	1	.000	833837.842		

Probability is of Membership for Incomplete Immunization
The Cut Value is .50
Symbols: C - Complete Immunization, I - Incomplete Immunization
Each Symbol Represents 2 Cases.

Table 16 reflected that the two variables were significant to immunization coverage. The household size had a p-value of 0.020, which was lower than the alpha level of 0.05. It indicated that the variable has only a 0.020 chance of error. Since it was less than the significance level, it was considered an influential variable to immunization coverage. Similarly, the parental vaccine literacy was also significant as it had a p-value of 0.000 which was less than the alpha level as well. The results of the multiple logistic regression were consistent with the outcome of the chi-square test. It proved that household size and parental vaccine literacy were associated with the immunization coverage of children aged above one up to five years old.

In the exponentiation of the B coefficient column [Exp (B)] or the odds ratio, the table revealed that smaller household size has 4.87 times more likely to have incomplete immunization than those families categorized as large household size. Additionally, parents with low vaccine literacy are 0.835 times more likely to have incomplete immunization than those with high vaccine literacy. Small household size and low parental vaccine literacy were vulnerable to incomplete immunization.

Presented in Table 17 is the actual cross-tabulation of household size, parental vaccine literacy, and immunization coverage. It showed that all 11 (100%) respondents who belong to small household sizes with low vaccine literacy rates were not able to have incomplete immunization. Three children living in large household sizes with low vaccine literacy rates also responded that they all had incomplete immunization. 74 children fell under the category of small household size with highly literate parents. And 39 out of the 74 children (52.7%) were completely vaccinated while the other 35 (47.3%) had incomplete vaccination. Lastly, a total of 17 children belong to a large household with highly literate parents. Only two (11.8%) of them had incomplete immunization, while the remaining 15 (88.25%) children were fully immunized.

Table 17. Cross Tabulation: Household Size * Immunization Coverage * Vaccine Literacy

VACCINE LITERACY				IMMUNIZATION COVERAGE		Total
				Complete Immunization	Incomplete Immunization	
Low	HOUSEHOLD SIZE	Small	Count		11	11
			% within HOUSEHOLD SIZE		100.0%	100.0%
		Large	Count		3	3
			% within HOUSEHOLD SIZE		100.0%	100.0%
	Total		Count		14	14
			% within HOUSEHOLD SIZE		100.0%	100.0%
Higprh	HOUSEHOLD SIZE	Small	Count	39	35	74
			% within HOUSEHOLD SIZE	52.7%	47.3%	100.0%
		Large	Count	15	2	17
			% within HOUSEHOLD SIZE	88.2%	11.8%	100.0%
	Total		Count	54	37	91
			% within HOUSEHOLD SIZE	59.3%	40.7%	100.0%
Total	HOUSEHOLD SIZE	Small	Count	39	46	85
			% within HOUSEHOLD SIZE	45.9%	54.1%	100.0%
		Large	Count	15	5	20
			% within HOUSEHOLD SIZE	75.0%	25.0%	100.0%
	Total		Count	54	51	105
			% within HOUSEHOLD SIZE	51.4%	48.6%	100.0%

Table 18. Predicted Probability Matrix Summary

VACCINE LITERACY	VACCINE LITERACY level	HOUSEHOLD SIZE	Predicted Probability	Predicted Group
68.18	Low	Small	0.95505	Incomplete Immunization
81.82	High	Small	0.64143	Incomplete Immunization
72.73	Low	Large	0.64933	Incomplete Immunization
81.82	High	Large	0.44828	Complete Immunization

Table 18 showed the matrix summary of all the possible combinations of household size and vaccine literacy along with their predicted probability and group. The children living in small household sizes and whose parents with low vaccine literacy had a 95.51% chance of having incomplete immunization. The predicted probability of this combination was the highest among other pairs. It is followed by the children in large household sizes whose parents got low vaccine literacy; they had a 64.93% predicted probability of experiencing incomplete immunization. Moreover, there is a 64.19% chance of incomplete immunization for those children in small household sizes whose parents have high vaccine literacy. The least predicted probability of having incomplete immunization is equal to 44.83%, which belonged to children that were members of large household size and whose parents were highly literate in vaccination. Since it had the least predicted probability of having incomplete immunization, the predicted group of these children was to have complete immunization.

5. Conclusion

This study has analyzed the relationship of immunization coverage and selected non-price determinants that affect such, specifically parental/caregiver vaccine literacy, the distance of the household's residence to a health facility, and the household size. From the statistical tests conducted, it was determined that parental/caregiver vaccine literacy and household size were significant to immunization coverage, while a distance of the household's residence to a health facility is found to have no significance on immunization coverage.

The statistical results and the findings of the related literature that discussed the relationship of parental/caregiver vaccine literacy and immunization coverage were consistent in the conclusion that a higher parental/caregiver vaccine literacy has a positive relationship with full immunization coverage. All respondents correctly answered the questions on the effects of vaccines, and the majority are also aware of the correct vaccination schedule and information on EPI. Moreover, the survey results found that the parents and caregivers have scored lowest with questions on vaccine benefits compared to the other sections. Additionally, results also show the parent or caregiver's lack of time to accompany the child to the vaccination site and unavailability of the vaccine during the child's visit are factors to the child having incomplete immunization. Since the parent or caregiver is knowledgeable on the benefits and effects of vaccination on their child, they are more inclined to have their children vaccinated. Furthermore, as they are knowledgeable of the vaccination schedule and the corresponding dosages of the vaccines, they are more conscious of adhering to a timely vaccination schedule.

Outcomes of related studies on distance did not correspond with the results of this study that a shorter distance of the household's residence to the health facility would result in complete immunization of children. This study found that despite the place of residence being less than a 15-minute walk away, the immunization of children is still incomplete. The insignificance of the distance to the health facility might be attributed to reasons such as the lack of transportation and difficult accessibility. Some residences are out of the route of the jeepneys, the only public transportation available on the study site. *Pedicabs* could be a transportation method; however, they are meagre in the area. Additionally, some of the_residents still need to cross an overpass before reaching the vaccination site. Another reason could be the subjective measurement of walking time which is considered as a limitation in this study since it did not use any instrument in measuring the respondents' walking time.

The results of this study that household size has a positive effect on immunization coverage ran contrary to the findings of the related literature that illustrated the negative effect of household size on immunization coverage. This study showed that as household size increases, the likelihood that the child will have complete immunization also increases. This could be inferred by the recurrence of vaccination among the siblings that made the parent or caregiver aware of the vaccine's effects and benefits.

5.1 Policy Implication

With this study, the researchers intend to provide the results of this study to the barangay, which could give insights on issues affecting immunization coverage that need to be addressed. Moreover, the results of this study would support the objectives of the EPI by the DOH that was mandated by the R.A. No. 10152. It would be a useful tool in spreading awareness on immunization benefits and risks, thereby supplementing vaccine education and reinforcing immunization confidence.

Overall, the findings of this paper, together with the EPI and R.A. No. 10152 would be beneficial in the improvement of immunization coverage of children. Through vaccine campaigns and awareness and effective planning, monitoring, and distribution of basic vaccines, children in Barangay 845, Pandacan, Manila, would be provided with a greater opportunity to complete their immunization.

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