Knowledge among the rural parents about the vaccinations and vaccination coverage of children in the first year of life in Papua New Guinea – analysis of data provided by Christian Health Services

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Abstract

Knowledge among the rural parents about the vaccinations and vaccination coverage of children in the first year of life in Papua New Guinea – analysis of data provided by Christian Health Services.

Background

The aim of this analysis was to establish knowledge among the rural parents about the vaccinations and vaccination coverage of children in the first year of life in Papua New Guinea (PNG).

Methods

56 parents including 52 mothers and 4 fathers from 2 areas Simbu Province (Kervagi district) and Morobe Province (Finschhafen district).

We analysed knowledge among the rural parents about the diseases prevented by vaccinations. data on vaccination coverage from 2016 to 2018 from all Catholic health facilities. Analysed vaccinations were the pentavalent vaccine (DTaP-HiB-HepB) and measles vaccine given in the first year of life.

Results

During the analysed period a total of 25,502 doses of measles vaccine was given, 31,428 children were vaccinated with the pentavalent vaccine. In 2016, the coverage rate for the measles vaccine was 26.6% and 33.4% for the pentavalent vaccine. In 2017, the coverage rate for measles and pentavalent vaccines was 12.5% and 16.6%, respectively. There were big differences in immunization coverage between provinces. In 2016, greater than 80% coverage was noted in one province for measles vaccine and in four provinces for pentavalent vaccine. In 2017, in none of the provinces, the coverage rate, neither for pentavalent nor for measles vaccine, was higher than 80%. A decreasing trend in the number of administered vaccinations was observed.

Conclusion

The results of this analysis demonstrate that in PNG, the majority of children are not fully immunised.

There are big differences in the vaccination coverage between provinces. As protection from diseases is low, there is a very high risk of an outbreak of the vaccine-preventable disease in the community.

Delivery of vaccinations in PNG encounters many barriers from access to healthcare services to natural disasters and inter-tribial conflicts.

Trial registration NA

Background

Papua New Guinea (PNG) has a population of around 8 million people, with a birth cohort estimated at 200,000 children (1,2). This is a country where vaccine-preventable diseases are still a problem. In 2017, according to Annual Report on Child Morbidity and Mortality in PNG, there were 11 cases of tetanus (4 deaths), 25 cases of whooping cough, 28 cases of acute flaccid paralysis (3 deaths) and 3 cases of measles (3). Recent cases of polio just reminded of this and drew attention to that unresolved problem. The first patient diagnosed with polio was a 6-year-old boy from Lae in Morobe Province diagnosed with polio on 24 April 2018. Vaccine-derived poliovirus type 1 (VDPV1) was then isolated from the stool of two community contacts of the index case. Circulation of poliovirus within the community raised a problem of vaccination coverage and population immunity. So far in 2018, 18 cases of VDPV1 infections were diagnosed (3,4,5). PNG achieved a polio-free status in 1997 (certified in 2000) (6). In 1988, the World Health Assembly declared eradication of poliomyelitis in the world by 2000. In PNG, the National Health Plan aimed at eradication of poliomyelitis by 1995 (7). Unfortunately, this plan did not come true (8). PNG's introduction of inactivated Poliovirus vaccine (IPV) given intramuscular in August 2015, with support from Global Alliance for Vaccine and Immunization (GAVI), was part of the Polio Eradication and Endgame Strategic Plan, which is targeting one of the fastest vaccine roll-outs in history - the introduction of at least one dose of intramuscular polio vaccine into the routine immunization schedules of all GAVI-supported countries (9,10,11,12). The vaccine protects children from the poliovirus, and unlike oral polio vaccine (OPV) does not lead to vaccine-derived polio.

In PNG, the program of immunization was launched in 1977, providing vaccinations against tuberculosis, polio, diphtheria, pertussis and tetanus. In 1981, Expanded Program on Immunization (EPI) was started. In 2009, the pentavalent vaccine replaced the tetravalent vaccine used in 2007 and 2008. Pneumococcal vaccine was introduced in 2013. The GAVI supports the introduction of the new vaccines. Vaccinations supported in PNG by GAVI are measles, polio, pneumococcal and pentavalent vaccines (9).

Immunization services in PNG are organized by the Family Health Unit in the Health Improvement Branch of the National Department of Health, and they are offered as a part of public health services through a network of 800 Maternal and Child Health (MCH) clinics. Provincial Cold Chain Logistics Officers (PCCLO) are responsible for the management of vaccines at a provincial level with support from the Provincial Family Health Coordinator. At the district level, EPI is managed by the District Manager through the health facility (Maternal & Child clinics and Well Baby clinics) Sister-In-Charge. It covers 30% of children, the rest of the children are reached through outreach services. There are 29 outreach clinics for every 1000 children under the age of 5 years (2). Approximately 63% of health facilities in PNG are government-owned, and the remaining are organized by religious organizations. Church organizations offer a significant proportion of immunization services, and 99% of the population declares Christian religion (1,2). Population targeted by EPI include those in the first year of life, children entering and leaving school (age 6 and 13 years) and pregnant women. Vaccination schedule in PNG is presented in Table 1.

Monitoring of vaccination is done by the National Health Information System. It is difficult to establish actual vaccination coverage due to the absence of recent coverage survey. There are different types of

data provided by the government (Sector Performance Annual Review), the World Health Organization (WHO) and UNICEF (14,15).

Available data from National Health Information System, WHO and UNICEF estimates are presented in Table 2. Differences between data make it very difficult to analyse it and share it with the provinces. All reports indicate a decrease in vaccination coverage, with a simultaneous dynamic increase in the number of inhabitants in the last 5 years (13,14,15). The aim of this analysis was to assess knowledge among rural parents about the diseases prevented by vaccinations and to establish vaccination coverage in PNG.

Material And Methods

Information on vaccinations was collected through a standard questionnaire (most items were close-ended, with multiple choices). The structured questionnaire collected data on sociodemographic characteristics, vaccination status, and knowledge on having an infectious disease in the past. Parents were asked to bring children vaccination booklet, if available. The individuals' vaccination status is verified by checking their vaccination certificate that provides details on both compulsory and recommended vaccines. It was an interview with a manual recording by trained data collectors. Data obtained from questionnaires were be uploaded to excel forms (no personal data were introduced to the system). Questionnaires are included as supplementary files.

Analysis of vaccination data provided by CHS from 2016 to 2018. Each year the population of children younger than one year covered by CHS was around 50,000 which is $\frac{1}{4}$ of the birth cohort. The target population was based on data from the Census. The CHS of PNG is the organization that represents all Christian Churches that provide health care service throughout PNG. CHS gets its funding from the Government of PNG through the National Department of Health. CHS is responsible for managing all 29 church-run health agencies within PNG. There are 713 healthcare facilities (hospitals, urban clinics, health centres, aid posts) in 22 provinces. We analysed data on vaccination coverage from 2016 to 2018 from all Catholic health facilities that provide vaccinations in all PNG provinces. Analysed vaccinations were the pentavalent vaccine (DTaP-HiB-HepB) and measles vaccine given in the first year of life.

Patient and Public Involvement

The researchers did not assume any significant risk to themselves and to the participants; the data are not of sensitive category. We adopt an implied consent which assumes that when, following the information about the study, the participant agrees to self-administer the questionnaire or participate in the interview he/she agrees to take part in the study. The study received approval of the ethics committee of the Divine Word University.

Results

A total of 56 parents, including 52 mothers and four fathers from 2 areas Simbu Province (Kervagi district) and Morobe Province (Finschhafen district) participated in the interview. The education level of

participating parents was very low: 6 had never been to school, 17 was four or less grade, 29 have 5-8 grade, 7 have 9 or 10 classes completed. The average number of children in families was 2.5 children. The range of age for participating children varies between 9 months and nine years, while the average age of participating children was 3.3 years. Thirty-eight out of 56 parents (68%) have no vaccination records in the child's health book.

The majority of parents (26 out of 56; 46%) understood that the vaccine prevents the child from the sick". Other single opinions were that "vaccination can prevent a child for disability" and "help a child to grow well" Almost all the women (50 out of 56) admitted to having no idea how a vaccination works. Only a few women mentioned that vaccination: "allow a child to grow," or "strengthen the child." Seventy percent thought that the reason for vaccination is to prevent the sick (40 out of 56) or even death. To persuade other parents to vaccinate their child, the highest proportion (38%, 21 out of 56) will inform that vaccination "prevent a child from becoming sick" or from death. Others will provide a more general statement that vaccinated children "grow well." Knowledge of diseases that can be prevented by vaccinations was shallow. The most frequent known disease was polio 18 people, and TB 15. Other conditions were tetanus and hepatitis B mentioned by four parents. The average number of known diseases preventable by vaccination was 0.8.

During the analysed period, 31,428 children were vaccinated with the pentavalent vaccine and a total of 25,502 doses of measles vaccine were given. Details are also presented in Table 4 and 5 (Suppl). In 2016, the coverage rate for the measles vaccine was 26.6% and 33.4% for the pentavalent vaccine. In 2017, the coverage rate for measles and pentavalent vaccines was 12.5% and 16.6%, respectively. There were big differences in immunization coverage between provinces (Fig. 1). In 2016, greater than 80% coverage was noted in one province for measles vaccine and in four provinces for pentavalent vaccine. In 2017, in none of the provinces, the coverage rate, neither for pentavalent nor for measles vaccine, was higher than 80% (Fig. 2). A decreasing trend in the number of administered vaccinations was observed.

Eighteen children had vaccination booklet, half of them had one vaccination visit. The commonest given vaccine was DTP, followed by measles and rubella vaccines given in 16 patients. Details are presented in Table 3.

Discussion

Our analysis showed large differences between vaccination coverage in each province. In some medical facilities, the vaccination coverage was even more than 100%. This does not mean that some children were vaccinated twice, but that there were more children than before. It was a case in 10 health facilities in 3 provinces, NCD, Enga and Manus. The lowest coverage was in Gulf, Eastern Highlands and East Sepik. In these provinces, at least 60% of the population lives in areas not accessible by road. The access to services can be, in these provinces, the biggest problem in vaccines delivery. The vaccination coverage in Morobe province is equal to median vaccination coverage in PNG. In contrast, Chibu province within the analyzed period experienced a marked decline in vaccination rates – to rates lower comparing to the country average.

In PNG, there is often only one static clinic per week at the health centre level, resulting in long waiting time for services. Although vaccinations are free of charge, some health facilities require user fees to run the operational costs. This discourages attendance at clinics unless the child is actually sick. It is proved by a mean number of outpatient visits per person per year, which in PNG is 1.28 (13). Neonatal mortality and under 5-year mortality are among the highest in this region of the world (57/1000 live births) (1,2,13). Services provided by the healthcare facilities also experience many troubles: lack of vaccinations, 30% of healthcare facilities are experiencing problems with vaccinations supply or problems with maintaining cold chain (13). The other problem is a suboptimal number of healthcare professionals. According to the official data in PNG, there are 32 paediatricians, 0.5 physicians per 10,000 population and 5.3 nurses per 10,000 population (2).

PNG has a relatively low coverage of essential services (Universal Health Coverage) according to WHO (15). Antenatal care is an indicator of access to and use of health care during pregnancy, and its low use is one of the well-known risk factors for incomplete vaccination. Mean antenatal care use in PNG is estimated at 54% (16). It varies between provinces, from 30% in Jiwaka to 98% in NCD (13). In regions with the lowest use of antenatal care, the vaccination coverage provided by CHS was also low. In a study conducted by Russo in Cameroon, children born at health facilities had a higher immunization coverage rate, compared to those born at home (17). The percentage of supervised deliveries in PNG is estimated at 37% (13).

The other problem is lack of the public understanding the need for vaccinations (18,19). There are huge difficulties in communication. The adult literacy rate is estimated at 63.4 % (1). So far, no negative opinions about vaccinations have been noticed in PNG, but the understanding of an idea of vaccinations is poor. For some people, there is no difference between vaccination – prevention and treatment. They view injection as a treatment. The expected benefit of participation in the survey can be raising awareness of vaccinations and their importance in protection not only for children but also for adults.

Natural disasters and military conflicts also cause difficulties in access to health services.

On 26 February 2018, the earthquake took place in four provinces Hela, Southern Highlands, Western Province and Enga. 544,000 people were affected (46% children; 17,419 children in age 0-12 months). This natural disaster was then followed by inter-communal fighting in Hela Province.

This also caused huge problems in vaccination. Out of 86 health facilities, 18 were severely damaged. As estimated by UNICEF, only 10% of the target population (children younger than five years) received pentavalent and MR vaccination in this province (20).

According to the National Health Information System, the measles vaccine coverage in 2016 was 51% (13). None of the provinces reported over the target 80%. The proportion of districts reporting less than 50% DTP3 (all 3 doses of vaccine) coverage was as high as 60%. Only 8% of provinces reported vaccination coverage greater or equal to 90%.

Data concerning the vaccine coverage obtained from CHS are much lower than the official ones. Data recording and reporting in health facilities was a shortcoming, identified earlier by researchers performing studies in PNG (21,22,23). Wiesen in 2014 in a study on assessing the hepatitis B birth dose vaccination program in PNG, found out that only 17% of the health facilities were able to provide a vaccination coverage figure.

The problem with estimation of the vaccination coverage is also caused by lack of reliable demographic data. In PNG, birth and death registration systems are not yet sufficiently developed to allow accurate estimation of a birth cohort. The population is growing very fast; hence, a real birth cohort seems to be bigger. Latest polio epidemic showed that paediatric population might be bigger than assumed. In the first round of catch-up vaccination action covering the three high-risk provinces of Morobe, Madang and Eastern Highlands, the estimated number of children was 289,582 but 303,907 (105%) children under 5 years old were vaccinated (4).

A field survey is another way to obtain the vaccination coverage. It can be done by checking patients' vaccinations records. But in PNG, the so-called baby book is missed very often. In a survey conducted by Samiak, according to medical records of 70 patients and based on the interview with parents, only 15% of children had complete vaccination status (19). In our analysis, only 18/56 had patients had baby books; 68 % had no vaccination records. Based on vaccination records, half of the patients had only one vaccination visit.

Community protection can be established by an adequate level of vaccination. Herd immunity effect is greatest when vaccination is given early in the childhood. The threshold depends on the infectiveness of the diseases and the efficacy of vaccinations. Measles is among the most highly transmissible infections. Its crude herd immunity threshold is 95%. In analysed villages, only 16 patients had proofs of being vaccinated against measles and rubella. Because the efficacy of the vaccine is approximately 95%, so population coverage should be 100% (24). For polio, community protection is established at 95% of the vaccination coverage. It also depends on hygiene standards (24).

Latest polio outbreak showed lack of community protection. In Morobe and Madang provinces, the vaccination coverage in children in the first year of life was far below advised. During an outbreak, catch up vaccinations were performed. The National Health Department with the help of Provincial Health Authorities organised four round immunization campaigns from July to October 2018 to immunize children under 5 years (5). More than 5.7 million doses of OPVs had been

procured for use in the vaccination campaign. This is much more than assumed based on the population number (children population under 5 years of age is around 1,000,000) (5). As a result of the recent polio campaign, 15/56 patients had proof of at least one dose of OPV.

Improving vaccination coverage in PNG is essential for outbreak control. To achieve this, it is necessary to improve the quality of services delivered by healthcare facilities and increasing community awareness

of the role of vaccinations. Observed in our analysis, declining coverage rates are in accordance with data provided by GAVI, WHO and Country Official estimates. This is a very worrisome trend.

Conclusion

The results of this analysis demonstrate that in PNG, the majority of children are not fully immunised.

There are big differences in the vaccination coverage between provinces. As protection from diseases is low, there is a very high risk of an outbreak of the vaccine-preventable disease in the community.

The big problem is lack of the public understanding the need for vaccinations.

Lack of patient vaccination records make it difficult to establish individual vaccination history.

Disclosures

Ethical Approval and Consent to participate

The study received ethical approval from the Ethical Comitee of Divine Word University in PNG.

Consent for publication

All the authors gave consent for publication.

Availability of data and materials

All the data are available upon request.

Competing interests

All the authors declare no competing interests.

Funding

Not applicable

Authors' contributions

Ewelina Gowin study design, statistical analysis, data interpretation, manuscript preparation, literature search,

Jerzy Kuzma study design, data collection, manuscript preparation,

Danuta Januszkiewicz-Lewandowska study design, data interpretation, manuscript preparation, literature search,

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References

1. National Statistical Office of Papua New Guinea. Population. Available at: <http://www.nso.gov.pg/index.php/population-and-social/other-indicators> [accessed 28.10.15].
2. Government P. PNG National Census data 2011. <http://sddspoint/en/resources/document-library?view=preview&format=raw&fileId=218>. 2011.
3. Annual-Child-Morbidity-and-Mortality-Report 2017 <http://pngpaediatricsociety.org/wp-content/uploads/2013/05/2017-Annual-Child-Morbidity-and-Mortality-Report.pdf>
4. WPRO | Papua New Guinea to vaccinate 700,000 in second round of polio campaign. WPRO. 2018 [cited 2018 Oct 1]. Available from: <http://www.wpro.who.int/papuanewguinea/mediacentre/releases/20180823-png-secondround-polio-vaccination/en/>
5. WPRO | Polio immunization drive starts 16 July in Papua New Guinea. WPRO. 2018 [cited 2018 Oct 1]. Available from: <http://www.wpro.who.int/papuanewguinea/mediacentre/releases/20180711/en/>
6. Siba PM. Papua New Guinea certified polio-free—complacency threatens dreams eradication. P N G Med J. 2005 Dec;48(3–4):139–40.
7. Papua New Guinea Department of Health. Papua New Guinea National Health Plan 1991-1995. Port Moresby. National Department of Health; 1991.
8. World Health Organization Regional Office for the Western Pacific. Report of the Thirteenth Meeting of the Technical Advisory Group on the Expanded Programme on Immunization and Poliomyelitis Eradication in the Western Pacific Region, Manila, 4-7 Nov 2002. Manila: World Health Organization; 2003. Report No.: Document EB142/37. Available from: http://www.wpro.who.int/sites/epi/documents/DOC_MTGRPT_TAG13.pdf.htm
9. GAVI Alliance Annual Progress Report <https://www.gavi.org/country/papua-new-guinea/14>
10. Laharriya C. WHO Global eradication of polio: the case for “finishing the job.” Bulletin of the World Health Organization. 2007;85(6):421–500.
11. GPEI – Global Polio Eradication Initiative. Available from: <http://polioeradication.org/>
12. Centers for Disease Control and Prevention (CDC). Evaluating surveillance indicators supporting the Global Polio Eradication Initiative, 2011-2012. MMWR Morb Mortal Wkly Rep. 2013 Apr 12;62(14):270–4.
13. Health PNGNDo. Sector Performance Annual Review: 2011–2015. Accesed online: http://www.healthgovpg/publications/2015_SPARpdf. 2015.
14. United Nations/UNICEF. Papua New Guinea consolidated results report for 2012–2015 Planning. Available from: http://www.unicef.org/about/execboard/files/Papua_New_Guinea_CRR-2008-2011_with_summary.pdf

15. WHO vaccine-preventable diseases: monitoring system 2017 global summary: Papua New Guinea reported immunization coverage [database on the Internet]. World Health Organization 2017 http://apps.who.int/immunization_monitoring/globalsummary/countries?countrycriteria%5Bcountry%5D%5B%5D=PNG
16. Morgan C. Enhancing pregnancy outcomes. A joint program of UNICEF PNG and the PNG National Department of Health, implemented by the PNG National Institute of Medical Research: Burnet Institute 2008; 22nd April
17. Russo G, Miglietta A, Pezzotti P, *et al.*: Vaccine coverage and determinants of incomplete vaccination in children aged 12–23 months in Dschang, West Region, Cameroon: a cross-sectional survey during a polio outbreak. *BMC Public Health*. 2015; **15**: 630.
18. Toikilik S., Tuges G., Lagani J., Wafiware E., Posanai E., Coghlan B., *et al*: Are hard-to-reach populations being reached with immunization services? Findings from the 2005 Papua New Guinea national immunization coverage survey. *Vaccine* 2010; 28: pp. 4673-467915
19. Louis Samiak, Theophilus I. Emeto. Vaccination and nutritional status of children in Karawari, East Sepik Province, Papua New Guinea. *PLoS One* 2017; 12(11): e0187796
20. Papua New Guinea Humanitarian Report No4 2018
21. Wiesen E, Lagani W, Sui G, Arava J, Reza S, Diorditsa S, Lin Y. Assessment of the hepatitis B birth dose vaccination program, Papua New Guinea, 2014. *Vaccine*, 2016-01-12;34:367-372.
22. Riddell M, Senn N, Clements CJ, Hobday L, Cowie B, Kurubi J, Kevin A, Siba P, Reeder JC, Morgan C. Rubella control in Papua New Guinea: age-specific immunity informs strategies for introduction of rubella vaccine. *Vaccine*. 2012 Dec 14;30(52):7506-12.
23. Senn N., Riddell M., Omena M., Siba P., Reeder J.C., Clements C.J., *et al*: Measles in Papua New Guinea: an age-specific serological survey. *Vaccine* 2010; 28: pp. 1819-1823
24. Fine PEM. Herd immunity: history, Theory, practice. *Epidemiol. Rev.* 1993;15:265-302

Tables

Table 1. Vaccination schedule in PNG

Vaccine	Age at administration
BCG (<i>Bacillus Calmette–Guérin, vaccine against tuberculosis</i>)	birth
HepB (<i>vaccine against hepatitis B</i>)	birth
DTP Hib HepB (<i>vaccine against diphtheria, tetanus, pertussis, Haemophilus influenzae type B, and hepatitis B</i>)	1, 2, 3 months
IPV (<i>inactivated poliovirus given by injection</i>)	3 months
MR (<i>vaccine against measles and rubella</i>)	6, 9, 18 months
OPV (<i>weakened poliovirus given by mouth</i>)	1, 2, 3 months
Pneumococcal (<i>vaccine against Streptococcus pneumoniae</i>)	1, 2, 3 months
TT (<i>Tetanus toxoid vaccination</i>)	7, 13 years

Table 2. Vaccination coverage in PNG in years 2014-2017.

		2014	2015	2016	2017
DTP	National data	61%	54%	44%	51%
vaccine	WHO/UNICEF estimates	73%	73%	72%	62%
Measles	National data	65%	60%	51%	43%
vaccine	WHO/UNICEF estimates	84%	79%	70%	62%

Tab 3. Vaccination status based on child's book from the rural setting of Papua New Guinea, 2019.

One vaccination visit	9
Two vaccination visits	3
Three vaccination visits	6
Measles vaccine	16 (8 1dose; 6- 2 doses, 2 – 3 doses)
Mumps vaccine	0
Rubella vaccine	16 (8 1dose; 6- 2 doses, 2 – 3 doses)
Varicella vaccination status	0
Te De Pe (DTP) vaccinated	17
Hepatitis B vaccination x1dose	16
Hepatitis B vaccination x 2 doses	5
Hepatitis B vaccination x 3 doses	1
Polio Oral vaccination x1 dose	15
Polio Oral vaccination x2 doses	7
Polio Oral vaccination x3 doses	6
BCG scar present	18

Figures

Figure 1

Vaccination service utilization in the clinics

Figure 2

Percentage of 3 doses of pentavalent and measles coverage in children under 1 year of age in all provinces of PNG