

PARENTS' KNOWLEDGE ON PNEUMOCOCCAL VACCINE AND OPINIONS ON PAYMENT STRATEGIES IN MALAYSIA

Dr Sharon Linus-Lojikip

Clinical Research Centre, Ministry of Health Malaysia

Hospital Raja Permaisuri Bainun, Jalan Raja Ashman Shah, 30450 Ipoh, Perak

Email: sharonlojikip.crc@gmail.com

Nur Fatin Zulaikha

Clinical Research Centre, Ministry of Health Malaysia

Hospital Raja Permaisuri Bainun, Jalan Raja Ashman Shah, 30450 Ipoh, Perak

Email: fatinzulaikhakarudin@gmail.com

Jazilah Mohamed Nor

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: enottycat@yahoo.com

Norain Ahamad Romazul

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: norain.romazul@gmail.com

Nur Hidayah Shamshuddin

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: nurhidayahshamshuddin@yahoo.com

Rosmaanira Ngah

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: rosmaanira_ngah@yahoo.com

Rosuzila Kamaruddin

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: fourleafclover.1008@yahoo.com

Sakinah Safiei

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: nina_880202@yahoo.com

Wan Afifah Wan Mazlan

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah, 31250 Tanjung Rambutan, Perak

Email: wanafifah_88@yahoo.com

Lai Jia Min

Clinical Research Centre, Ministry of Health Malaysia

Hospital Raja Permaisuri Bainun, Jalan Raja Ashman Shah, 30450 Ipoh, Perak

Email: jiaminlai.crc@gmail.com

Dr Heama Shunmugarajoo

Pediatric Department

Hospital Raja Permaisuri Bainun, Jalan Raja Ashman Shah, 30450 Ipoh, Perak

Email: haema77@gmail.com

Pn Norshazila Julia M.S

Kolej Sains Kesihatan Bersekutu Sultan Azlan Shah,

31250 Tanjung Rambutan, Perak

Email: norshazilajulia@gmail.com

Dato' Dr Amar-Singh HSS

Clinical Research Centre, Ministry of Health Malaysia

Hospital Raja Permaisuri Bainun, Jalan Raja Ashman Shah, 30450 Ipoh, Perak

Email: amarhss@gmail.com

ABSTRACT

Under the National Childhood Immunisation Program (NIP) in Malaysia, all Malaysian children are eligible to obtain 12 types of vaccines against major childhood infections, free-of-charge, from any public child-maternal healthcare facilities. Childhood vaccination against pneumococcal diseases using the pneumococcal conjugate vaccines (PCV) however, is currently optional, and it is only offered in the private healthcare sectors. We conducted a cross-sectional study to evaluate the awareness and knowledge of parents in Malaysia on childhood pneumococcal diseases, the extent of childhood PCV uptake, and payment opinion on PCV. This study was conducted in Malaysia at four states; Perak, Pahang, Melaka, and Johor, and at one federal constituent: Kuala Lumpur, from 31st December 2017 to 1st February 2018. Parents with children aged less than five years old were interviewed face to face by the researchers. Their knowledge about childhood pneumococcal diseases and vaccines, history on childhood PCV use, and payment opinion for childhood PCV were assessed. An educational explanation was given to parents who were not aware of childhood pneumococcal diseases and PCV. One hundred seventy-seven parents consented to participate in the study. It was found that 42.4% of them never heard about pneumococcal diseases, and 44.6% also never heard of PCV. Of those who knew about PCV, 38.8% had vaccinated at least one of their children with PVC, and 52.0% reported that the vaccines were easily accessible to them. Information from government clinics only constituted 10.8% of all information sources on PCV for the informed parents. After an educational explanation on pneumococcal diseases and PCV were given, 65.5% of all the parents reported that they were willing to pay the PCV for their children. Majority of them opined that the government should include PCV in the NIP for the public (98.9%). If PCV is included in the NIP, 98.3% of the parents were willing to vaccinate their children with the vaccine. Awareness level on childhood pneumococcal diseases among parents in Malaysia is not very high. Parents who are informed about the benefits of childhood pneumococcal vaccination may influence the vaccine's uptake positively.

Key words: Childhood pneumococcal knowledge, childhood pneumococcal vaccines, parents in Malaysia.

INTRODUCTION

Pneumococcal disease is a communicable disease that commonly affect young children especially those with weakened immune system (Van Aalst et al., 2018). It is caused by an organism (a bacterium) called *Streptococcus pneumoniae* and the infection in human is known as pneumococcal disease (Hausdorff, Feikin, & Klugman, 2005). It may cause many types of diseases namely pneumonia, meningitis, otitis media, sinusitis, septicaemia and osteomyelitis (Henriques-Normark & Tuomanen, 2013). Children under 5 years of age and especially those under 2 years old are at risk of contracting invasive pneumococcal diseases (IPD) which is a serious form of infection and it carries higher risk of morbidity (Tan, 2012). The case fatality rate for IPD found in developing countries can be as high as 80% (Maimaiti, Ahmed, Md Isa, Ghazi, & Aljunid, 2013). In Malaysia from the year 2014 to 2017, among children under 5 years old, 48% of IPD cases were from children less than 1 year old, 19.05% from children aged 1-2 years, and 33.0% from children aged 2-5 years old (Arushothy et al., 2019).

Vaccines to prevent IPD had been developed and used in many countries. Currently, there are two types of vaccines available in the Malaysian market to prevent IPD in children less than 2 years of age, namely PCV10 and PCV13 (Diaz et al., 2016) (Martín-Torres et al., 2015). The PCV can be given to healthy children as early as 2 months of age with subsequent booster doses at 4 months, 6 months and 12 to 15 months of age (Diaz et al., 2016) (Martín-Torres et al., 2015). Another variant of pneumococcal vaccines is the pneumococcal polysaccharide vaccines. It is used in adults, older children, individuals who are immune compromised, and in those who are susceptible towards pneumococcal diseases (Bruyn & van Furth, 1991).

Developed countries such as Taiwan, United States of America, and Australia had long included childhood pneumococcal vaccination in their NIP (Ward et al., 2015). Developing countries like Kenya, Yemen and Pakistan adopted such move beginning 2011 (Tricarico et al., 2017). Currently, in Malaysia, PCV vaccination is not included in the country's NIP. Therefore, it is not freely offered to the public under the country's NIP. Parents in Malaysia are required to seek PCV from sources that are reliable to them if they wish to vaccinate their children against pneumococcal diseases. The current average price for PCV per dose charged at the private health clinics in Malaysia ranges from RM200 to RM300 (Lai, 2019). Parents who were informed about the benefits of PCV and vaccinated their children with PCV, had to bear the cost for the additional vaccine injections.

Local studies in Malaysia had been conducted to measure the cost-effectiveness for the inclusion of childhood PCV in the country's NIP (Wu et al., 2016) (M. Darus, Akmal, & Redzuan, 2014). However, there are no published articles that studied the awareness and current uptake of childhood PCV in Malaysia yet. This study was therefore conducted to explore the knowledge about childhood pneumococcal diseases and vaccines among parents in Malaysia, their uptake on childhood PCV, and opinion on willingness to pay for the childhood pneumococcal vaccines.

METHODS

This is a cross-sectional study that was conducted from 31st December 2017 to 1st February 2018 in Malaysia at four states; Perak, Pahang, Melaka, and Johor, and at one federal constituent: Kuala Lumpur. Parents of any age, caring for children less than 5 years of age were recruited in a non-random manner to become study participants. They were identified during the study period inside main shopping complexes of the four states and federal constituent.

Consented parents were interviewed face to face by the researchers, using a pre-tested, self-developed questionnaire as a guide. The questionnaire contained five main domains that assessed parents' basic demography, knowledge about pneumococcal

diseases, awareness and knowledge about PCV, previous history on childhood vaccination with PCV, and payment opinion for childhood PCV. The study questionnaire was self-developed by the researchers and was not tested for reliability nor validated for use in the future study.

The researchers obtained informed consent for participation from each participating parent. There were no incentives given to the participating parents, nor any branded vaccines promotional activities involved in this study. An educational explanation was given to consented parents about pneumococcal diseases and childhood PCV during the interview if they were unaware of the disease or PCV. The field researchers comprised of registered nurses trained in the paediatric field.

A total of 177 parents were planned to be recruited in the study to estimate that 37% of parents in Malaysia were unaware of PCV availability, with 95% confidence level, desired precision of $\pm 7.5\%$, and an additional 10% of expected dropout rate.

RESULT

Response rate

The researchers approached 265 parents caring for children under five years of age and 177 parents gave consent for participation. Thirty-five parents were recruited from Perak, Melaka and Johor states respectively, while 36 parents were recruited from Pahang and Kuala Lumpur states respectively. The overall response rate for participation in this study was 66.8%.

Parents' characteristics

Majority of the parents were mothers (78%), with the mean age of 30.95 years (SD 6.23), were of Malays ethnicity (91%), had tertiary education level (55.4%) and worked in managerial field (35%). The median number of children living together with the parents was 2 (IQR 1.0). The mean age of their spouses was 32.97 years (SD 7.5). Most of their spouses also had tertiary education level (57.6%) and had managerial jobs (33.9%).

Most of the parents utilised government facilities to vaccinate their children for routine childhood immunisation (76.8%). Ten per cent of the parents routinely vaccinated their children both in the private clinics and government clinics, and an equal proportion (10%) of parents vaccinated their children in the private clinics alone. Three per cent of all the parents reported that they did not vaccinate their children at all. Supplementary File 1: Table 1 summarises the socio-demography characteristics of all the study participants and their children vaccination's history.

Parents' knowledge about pneumococcal diseases and its prevention

More than half of all the parents heard about the pneumococcal diseases before the study and therefore were aware of the disease (n=102, 57.6%). Those who heard about the disease, 81.4% knew that young children were mostly affected by pneumococcal diseases. These parents also responded that pneumococcal infection could cause lung disease (52.4%), followed by brain disease (21.7%), ear disease 13.8%), blood disease (6.9%), bone disease (3.2%) and skin disease (1.1%). Only 1.1% of the parents were unsure of the types of diseases pneumococcal infection can potential caused. Ninety-two per cent of the parents who knew about pneumococcal diseases reported that PCV vaccination could prevent the disease, 74.5% reported that traditional medicine could not prevent the disease, and 70.6% reported that good hygiene could prevent pneumococcal diseases. Please see Supplementary File 1: Table 2 for parental knowledge about pneumococcal diseases.

Parents' awareness about PCV and experience on PCV use

A large proportion of the parents also have heard about the availability of PCV before the study (55.4%, n=98). Thirty-eight per cent of them (95%CI; 29.28%, 49.21%) reported that they had vaccinated at least one of their children with PCV previously. The vast majority of those who had not reported the intention to vaccinate their children in the future (83.3%). Please refer to Table 1: Current PCV use and intention on the future use of PCV.

Table 1: Current PCV use and intention on the future use of PCV

| | Statistic, n (%) | |
|---|------------------|--------|
| Have you vaccinated your child/children with PCV before? ^a | | |
| • Yes | 38 | (38.8) |
| • No | 60 | (61.2) |
| If No, do you intent to let your child/children receive this vaccine in the future? ^{a b} | | |
| • Yes | 50 | (83.3) |
| • No | 10 | (16.7) |
| Are all your children vaccinated with PCV? ^{a c} | | |
| • Yes | 31 | (81.6) |
| • No | 7 | (18.4) |

^a Data based on responses from 98 parents who heard about the pneumococcal vaccine

^b Data based on responses from 60 parents who did not vaccinate their child with PCV

c Data based on responses from 38 parents who had vaccinated their child with PCV

A higher percentage of parents who vaccinated their children with PCV reported to routinely utilised the government facility for their children's childhood vaccination (44.7%). Of those who routinely visited the private clinics for their childhood vaccination, 62.5% of them added PCV in their children's vaccination plan. This study also identified a small percentage of parents who did not vaccinate their children (3.1%). Please see Table 2 for the routine vaccination facilities data tabulation.

Table 2. Routine vaccination facilities for childhood immunisation

| Where did you vaccinate your child/children for routine childhood vaccination? ^a | Vaccinated children with PCV, n (%) | | Total, n (%) |
|---|-------------------------------------|-----------|--------------|
| | Yes (n=38) | No (n=60) | |
| Government clinics | 17 (44.7) | 47 (78.3) | 64 (65.3) |
| Private clinics | 10 (26.3) | 6 (10.0) | 16 (16.3) |
| Mixed (Government and private clinics) | 11 (28.9) | 4 (6.7) | 15 (15.3) |
| Did not vaccinate | 0 (0) | 3 (100.0) | 3 (3.1) |

a Data based on responses from 98 parents who heard about the pneumococcal vaccine

Most of the parents who vaccinated their children with PCV were influenced to use the vaccines by their family members (19.6%), followed by influence from the private clinic (19.1%), friends (18.2%), social media (17.3%), government clinic (11.1%), electronic media (6.7%), print media (5.8%) and others (2.2%). Fifty-two per cent of parents who had vaccinated their children with PCV reported that the vaccines were easily accessible. The overall childhood PCV uptake among all the interviewed parents was 21.5%. Please refer to Supplementary File 1: Table 3 for parents' awareness about the pneumococcal vaccine, sources of information and opinions on PCV.

Parents' willingness to pay for childhood pneumococcal vaccines and future use of vaccines

A large proportion of the parents opined that they were willing to pay for the PCV, although the current average price of the vaccines may exceed RM200/dose (65.5%, 95%CI: 57.94%, 72.37%). Fourteen per cent of them opined that they were not willing to pay for the PCV, and the remaining 19.8% were feeling unsure. Ninety-eight per cent (95%CI: 95.59%, 99.82%) of all the parents gave the opinion that the government should include the PCV in the NIP. If PCV is included in the NIP, 98.3% (95%CI: 94.72%, 99.56%) of the parents were willing to vaccinate their child with the added PCV. Parental characteristics were not associated with the current uptake of the childhood PCV vaccines (p>0.05). Please see Supplementary File 1: Table 4. Factors examined for PCV use among parents.

Table 3. Parents' opinion on willingness to pay for PCV and inclusion of PCV in the NIP

| | Statistic, n (%) | |
|--|------------------|--------|
| Are you willing to pay for PCV vaccination for your children? | | |
| • Yes | 116 | (65.5) |
| • No | 26 | (14.7) |
| • Unsure | 35 | (19.8) |
| In your opinion, should the government include PCV in the National Childhood Immunisation Programme, MOH? | | |
| • Yes | 175 | (98.9) |
| • No | 2 | (1.1) |
| If PCV is included in the National Childhood Immunisation Programme, MOH, would you be willing for your child to be vaccinated with it? | | |
| • Yes | 174 | (98.3) |
| • No | 3 | (1.7) |
| In your opinion, should the government clinic promote pneumococcal vaccine? ^a | | |
| • Yes | 96 | (98) |
| • No | 2 | (2) |

a Data based on responses from 98 parents who heard about the pneumococcal vaccine MOH: Ministry of Health

DISCUSSION

A sizable proportion of parents in Malaysia have heard about childhood pneumococcal diseases and PCV (57.4% and 55.4% respectively). Some were well informed that childhood pneumococcal vaccination in Malaysia is optional. Informed parents proactively vaccinated their children with PCV at the private healthcare clinics and this account for 38.8% of parents who were aware of the disease. This rate represents a crude childhood PCV uptake rate for families who had access to health information,

with internet-based media being the popular source for vaccine information. Among these parents, family influence for childhood PCV use was predominant, and their socioeconomic status was unrelated to the vaccine uptake.

We observed that a majority of the studied parents were less hesitant and showed higher intention to vaccinate their children against childhood pneumococcal diseases despite the added cost. This is evident by the high proportion of parents who expressed their opinion on willingness to finance PCV for their children after an educational explanation was given to them. The educational explanation delivered by the researchers probably improved the overall understanding of PCV. Its content included standard healthcare information on childhood pneumococcal diseases and PCV benefits. The content also was not associated with any vaccine brand names and was delivered at a personal level by trained registered nurses (field researchers). This approach may have contributed to parental trust and positive view of the informants (field researchers), and thus the information was perceived as beneficial rather than restrictive (Miton & Mercier, 2015).

Notably, a few parents who participated in the study did not vaccinate their children (3%). Most of the studied parents comprised of those who routinely vaccinated their children and therefore, supported the childhood vaccination policies established by the government. Ninety-eight per cent of all parents in this study opined that PCV should be promoted and included in the country's NIP. These signified public demand for vaccines that can prevent communicable diseases to be made accessible to all young children of various socioeconomic backgrounds.

There is also a growing demand for using childcare centres for very young children to allow employed mothers to continue working after the completion of maternity leave in Malaysia (Mashitah, Nik Salida Suhaila, & Arasy, 2018). The current Malaysian government presently is also increasing the establishment of a childcare centre in selected government facilities, as part of its strategy to improve the security of child nurseries and improve the working conditions for parents in Malaysia (Bernama, 2018b). Additionally, the private sector in Malaysia is also rewarded through tax redemption incentives if it renovates and maintains a building to set up child nurseries for its employees' utilisation (Bernama, 2018). With the encouraging move by the government to improve childcare services in Malaysia, childcare centre services may grow in the future. The likelihood of children at childcare nurseries being exposed to any communicable diseases at a younger age due to crowding, will also potentially be increased. From this perspective, including PCV in the NIP can be considered as a useful strategy to prevent the spread of pneumococcal diseases in young children.

This study has several limitations. The parents in this study were sampled from major shopping malls in selected states in a non-random manner. The crude estimation of PCV uptake rate and other findings (willingness to finance PCV) found in this study may not represent the population who resides in the rural or district areas. Nevertheless, this study approximated the PCV uptake by the public living in urban areas in Malaysia. Further studies are needed to evaluate public demand for childhood PCV and the current uptake rate in a broader context. Additionally, an on-going surveillance system that monitors the country's burden for invasive pneumococcal diseases is needed. This information is essential to develop a robust strategy and future policies for childhood pneumococcal vaccination program.

CONCLUSION

Pneumococcal conjugate vaccines (PCV) are vaccines that have been used by many developed countries to prevent the serious form of pneumococcal diseases in children. The awareness level of childhood pneumococcal diseases among parents in Malaysia found in this study is not very high. A continuous effort on public education about childhood pneumococcal diseases and vaccination against the disease and PCV benefits are essential to ensure parental acceptance and uptake of the vaccines.

REFERENCES

- Arushothy, R., Ahmad, N., Amran, F., Hashim, R., Samsudin, N., & Azih, C. R. C. (2019). Pneumococcal serotype distribution and antibiotic susceptibility in Malaysia: A four-year study (2014-2017) on invasive paediatric isolates. *International Journal of Infectious Diseases: IJID: Official Publication of the International Society for Infectious Diseases*, 80, 129–133. <https://doi.org/10.1016/j.ijid.2018.12.009>
- Bernama. (2018a). Government agencies to set up child nurseries by next year. *Free Malaysia Today*.
- Bernama. (2018b). Three ministries yet to set up childcare centre - Hannah Yeoh. *New Straits Times*.
- Bruyn, G. A. W., & van Furth, R. (1991). Pneumococcal polysaccharide vaccines: Indications, efficacy and recommendations. *European Journal of Clinical Microbiology & Infectious Diseases*. <https://doi.org/10.1007/BF02005442>
- Diaz, J., Terrazas, S., Bierrenbach, A. L., Toscano, C. M., Alencar, G. P., Alvarez, A., ... De Oliveira, L. H. (2016). Effectiveness of the 10-valent pneumococcal conjugate vaccine (PCV-10) in Children in Chile: A nested case-control study using nationwide pneumonia morbidity and mortality surveillance data. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0153141>
- Hausdorff, W., Feikin, D., & Klugman, K. (2005). Epidemiological differences among pneumococcal serotypes. *The Lancet Infectious Diseases*, 5(2), 83–93. [https://doi.org/10.1016/S1473-3099\(05\)70083-9](https://doi.org/10.1016/S1473-3099(05)70083-9)

Henriques-Normark, B., & Tuomanen, E. I. (2013). The pneumococcus: epidemiology, microbiology, and pathogenesis. *Cold Spring Harbor Perspectives in Medicine*, 3(7). <https://doi.org/10.1101/cshperspect.a010215>

Lai, L. (2019). Many young children not getting pneumococcal vaccine “due to cost.” *The Straits Times*.

M. Darus, N. (Health T. A. S. M. of H. M., Akmal, S. (Health T. A. S. M. of H. M., & Redzuan, A. (Health T. A. S. M. of H. M. (2014). Pneumococcal conjugate vaccine for children below five years old (Vol. MOH/P/PAK/).

Maimaiti, N., Ahmed, Z., Md Isa, Z., Ghazi, H. F., & Aljunid, S. (2013). Clinical Burden of Invasive Pneumococcal Disease in Selected Developing Countries. *Value in Health Regional Issues*, 2(2), 259–263. <https://doi.org/10.1016/j.vhri.2013.07.003>

Martinón-Torres, F., Czajka, H., Center, K. J., Wysocki, J., Majda-Stanislawski, E., Omeñaca, F., ... Gurtman, A. (2015). 13-Valent pneumococcal conjugate vaccine (PCV13) in preterm versus term infants. *Pediatrics*. <https://doi.org/10.1542/peds.2014-2941>

Mashitah, A. M., Nik Salida Suhaila, N. S., & Arasy, M. (2018). Quality enhancement of child care centre in Malaysia: An analysis on laws and regulations. *Journal of Education and Social Sciences*, 9(1), 23–28.

Miton, H., & Mercier, H. (2015). Cognitive Obstacles to Pro-Vaccination Beliefs. *Trends in Cognitive Sciences*, 19(11), 633–636. <https://doi.org/10.1016/j.tics.2015.08.007>

Tan, T. Q. (2012). Pediatric invasive pneumococcal disease in the United States in the era of pneumococcal conjugate vaccines. *Clinical Microbiology Reviews*, 25(3), 409–419. <https://doi.org/10.1128/CMR.00018-12>

Tricarico, S., McNeil, H. C., Cleary, D. W., Head, M. G., Lim, V., Yap, I. K. S., ... Clarke, S. C. (2017). Pneumococcal conjugate vaccine implementation in middle-income countries. *Pneumonia*. <https://doi.org/10.1186/s41479-017-0030-5>

Van Aalst, M., Lotsch, F., Spijker, R., van der Meer, J. T. M., Langendam, M. W., Goorhuis, A., ... de Bree, G. J. (2018). Incidence of invasive pneumococcal disease in immunocompromised patients: A systematic review and meta-analysis. *Travel Medicine and Infectious Disease*, 24, 89–100. <https://doi.org/10.1016/j.tmaid.2018.05.016>

Ward, K. F., Trent, M., Hull, B. P., Quinn, H. E., Dey, A., & Menzies, R. I. (2015). Evaluating the implementation of the 13-valent pneumococcal vaccine supplementary dose program in Australian primary health care settings. *BMC Health Services Research*. <https://doi.org/10.1186/s12913-015-0738-y>

Wu, D. B.-C., Roberts, C., Lee, V. W. Y., Hong, L.-W., Tan, K. K., Mak, V., & Lee, K. K. C. (2016). Cost-effectiveness analysis of infant universal routine pneumococcal vaccination in Malaysia and Hong Kong. *Human Vaccines & Immunotherapeutics*, 12(2), 403–416. <https://doi.org/10.1080/21645515.2015.1067351>

ACKNOWLEDGEMENTS

We would like to thank the Director General of Health Malaysia for his permission to publish this article (NIH.800-4/4/1 Jld. 74 (19)). We would also like to acknowledge all the parents who participated in this study.

DECLARATION

SLL prepared the first draft manuscript. All authors revised and contributed significantly to the write up of the final version of the manuscript. All authors approved the final version of manuscript for publication and accepted all responsibilities for its publication.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was registered in the National Medical Research Register (NMRR), Ministry of Health, Malaysia (NMRR ID: 17-2392-38335). It received ethical approval/clearance from the Medical Research & Ethics Committee (MREC) of the Ministry of Health, Malaysia (KKM.NIHSEC/P17-1809(5)). Participation in the study by the parents was voluntary and prior written informed consent obtained from all the participating parents.

FUNDING

This is an investigator-initiated research. There was no funding for this study.

COMPETING INTEREST

The authors declare that they have no competing interests.

AUTHOR'S CONTRIBUTION

JMN, NAR, NHS, RN, RK, SS, WAWM, NFZ, LJM, SLL, ASHSS, HS and NJMS were involved in the protocol development for the study. JMN, NAR, NHS, RN, RK, SS and WAWM contributed in the data collection. JMN, NAR, NHS, RN, RK, SS, WAWM, NFZ and LJM also contributed in the data analysis. All authors contributed to the write up of the final report of the study.

SUPPLEMENTARY FILE 1

Table 1: Socio-demography characteristics of study participants and their children vaccination's history

| Characteristics | Statistic, n (%) | |
|---|------------------|--------------------|
| Gender | | |
| • Male | 39 | (22.0) |
| • Female | 138 | (78.0) |
| Age (mean in years) | 30.95 | (6.2) ^a |
| Highest level of education | | |
| • No formal schooling | 3 | (1.7) |
| • Primary | 0 | (0.0) |
| • Secondary | 76 | (42.9) |
| • Tertiary | 98 | (55.4) |
| Ethnicity | | |
| • Malay | 161 | (91.0) |
| • Chinese | 8 | (4.5) |
| • Indian | 5 | (2.8) |
| • Others | 3 | (1.7) |
| Occupation | | |
| • Higher managerial | 8 | (4.5) |
| • Lower managerial | 54 | (30.5) |
| • Intermediate occupations | 5 | (2.8) |
| • Small employers and own account workers | 12 | (6.8) |
| • Lower supervisory and technical occupations | 20 | (11.3) |
| • Semi-routine occupations | 11 | (6.2) |
| • Routine occupations | 36 | (20.3) |
| • Never worked and long-term unemployed | 31 | (17.5) |
| Number of children currently living together (median) | 2 | (1.0) ^b |
| Spouse's Details | | |
| Age (mean in years) | 32.97 | (7.5) ^a |
| Highest level of education | | |
| • No formal schooling | 1 | (0.6) |
| • Primary | 4 | (2.3) |
| • Secondary | 70 | (39.5) |
| • Tertiary | 102 | (57.6) |
| Occupation | | |
| • Higher managerial | 15 | (8.5) |
| • Lower managerial | 45 | (25.4) |
| • Intermediate occupations | 10 | (5.6) |
| • Small employers and own account workers | 31 | (17.5) |
| • Lower supervisory and technical occupations | 24 | (13.6) |
| • Semi-routine occupations | 7 | (4.0) |
| • Routine occupations | 31 | (17.5) |
| • Never worked and long-term unemployed | 14 | (7.9) |
| • Government clinics | 136 | (76.8) |
| • Private clinics | 18 | (10.2) |

| | | |
|--|----|--------|
| • Mixed (Government and private clinics) | 18 | (10.2) |
| • Did not vaccinate | 5 | (2.8) |

a Standard Deviation

b Inter Quartiles Ranges

Table 2: Parents' knowledge about pneumococcal diseases

| | Statistic, n (%) | |
|--|------------------|--------|
| Have you heard about pneumococcal diseases in children? | | |
| • Yes | 102 | (57.6) |
| • No | 75 | (42.4) |
| Where did you get the info about pneumococcal diseases?^{a b} | | |
| • Social media | 60 | (19.7) |
| • Private Clinic | 53 | (17.4) |
| • Electronic Media | 51 | (16.7) |
| • Friends | 50 | (16.4) |
| • Government Clinic | 35 | (11.5) |
| • Family | 24 | (7.9) |
| • Print Media | 24 | (7.9) |
| • Others | 8 | (2.6) |
| Who are at more risk of developing pneumococcal diseases?^{a b} | | |
| • Babies (<1 year old) | 67 | (40.1) |
| • Young Child (1-5 years old) | 69 | (41.3) |
| • Older Child (6-12 years old) | 9 | (5.4) |
| • Teenager (12-18 years old) | 5 | (3.0) |
| • Adult (18< years old) | 10 | (6.0) |
| • Don't know | 7 | (4.2) |
| What kind of infection that pneumococcal infection cause?^{a b} | | |
| • Lung (Pneumonia) | 99 | (52.4) |
| • Brain | 41 | (21.7) |
| • Ear | 26 | (13.8) |
| • Blood | 13 | (6.9) |
| • Bone | 6 | (3.2) |
| • Skin | 2 | (1.1) |
| • Don't know | 2 | (1.1) |
| Can vaccination prevent pneumococcal diseases? ^a | | |
| • Yes | 94 | (92.2) |
| • No | 0 | (0.0) |
| • Don't know | 8 | (7.8) |
| Can traditional medicine prevent pneumococcal diseases? ^a | | |
| • Yes | 4 | (3.9) |
| • No | 76 | (74.5) |
| • Don't know | 22 | (21.6) |
| Can good hygiene prevent pneumococcal diseases? ^a | | |
| • Yes | 72 | (70.6) |
| • No | 9 | (8.8) |
| • Don't know | 21 | (20.6) |

a Data based on responses from 102 participants who heard about pneumococcal diseases

b Multiple responses are possible

Table 3. Parents' awareness about pneumococcal vaccine, sources of information and opinions on PCV

| | Statistic, n (%) | |
|---|------------------|--------|
| Have you heard about PCV before? | | |
| • Yes | 98 | (55.4) |
| • No | 79 | (44.6) |
| From where you heard about PCV? ^{a b} | | |
| • Social media | 66 | (20.9) |

| | | |
|---|----|--------|
| • Private Clinic | 52 | (16.5) |
| • Electronic Media | 47 | (14.9) |
| • Family | 37 | (11.7) |
| • Friends | 48 | (15.2) |
| • Government Clinic | 34 | (10.8) |
| • Print Media | 30 | (9.5) |
| • Others | 2 | (0.6) |
| Which sources of information that influenced your decision-making regarding vaccination with PCV? ^{a b} | | |
| • Family | 44 | (19.6) |
| • Private Clinic | 43 | (19.1) |
| • Friends | 41 | (18.2) |
| • Social media | 39 | (17.3) |
| • Government Clinic | 25 | (11.1) |
| • Electronic Media | 15 | (6.7) |
| • Print Media | 13 | (5.8) |
| • Others | 5 | (2.2) |
| Is PCV included in the NIP, MOH in Malaysia? ^b | | |
| • Yes | 16 | (16.3) |
| • No | 73 | (74.5) |
| • Don't know | 9 | (9.2) |
| Where you can get pneumococcal vaccine? ^{a b} | | |
| • Private clinic | 79 | (50.3) |
| • Private Hospital | 61 | (38.9) |
| • Government clinic | 13 | (8.3) |
| • Pharmacy | 4 | (2.6) |
| Is the pneumococcal vaccine easily accessible? ^b | | |
| • Yes | 51 | (52) |
| • No | 47 | (48) |

a Multiple responses are possible

b Data based on responses from 98 participants who heard about pneumococcal vaccine

Table 4: Factors examined for PCV use among parents

| | PCV use in children? | | Chi-square (df) | P value |
|---|----------------------|------------|-------------------------|---------|
| | Yes | No | | |
| Age in years (mean) | 30.1 | 30.30 | -0.115(96) ^a | 0.908 |
| Highest level of education | | | | |
| No formal schooling | 0 | 1 (1.7%) | 1.025 (2) | 0.599 |
| Primary | 0 | 0 | | |
| Secondary | 7(18.4%) | 14 (23.3%) | | |
| Tertiary | 31 (81.6%) | 45 (75%) | | |
| Ethnicity | | | | |
| Malay | 37 (97.4%) | 58 (96.7%) | 2.847 (2) | 0.241 |
| Chinese | 0 | 2 (3.3%) | | |
| Indian | 1 (2.6) | 0 | | |
| Occupation | | | | |
| Higher managerial | 3 (7.9%) | 4 (6.7%) | 9.813 (7) | 0.199 |
| Lower managerial | 19 (50%) | 20 (33.3%) | | |
| Intermediate occupations | 1 (2.6%) | 2 (3.3%) | | |
| Small employers and own account workers | 4 (10.5%) | 2 (3.3%) | | |
| Lower supervisory and technical occupations | 4 (10.5%) | 6 (10%) | | |
| Semi-routine occupations | 2 (5.3%) | 3 (5%) | | |

| | | | | |
|--|------------|------------|-----------|-------|
| Routine occupations | 3 (7.9%) | 7 (11.7%) | | |
| Never worked and long-term unemployed | 2 (5.3%) | 16 (26.7%) | | |
| Number of children | | | | |
| 1 | 18 (47.4%) | 30 (50%) | | |
| 2 | 12 (31.6%) | 19 (31.7%) | | |
| 3 | 7 (18.4%) | 4 (6.7%) | 5.299 (4) | 0.258 |
| 4 | 1 (2.6%) | 6 (10%) | | |
| 6 | 0 | 1 (1.7%) | | |
| Spouse's highest level of education | | | | |
| No formal schooling | 0 | 1 (1.7%) | | |
| Primary | 0 | 1 (1.7%) | | |
| Secondary | 8 (21.1%) | 16 (26.7%) | 1.820 (3) | 0.611 |
| Tertiary | 30 (78.9%) | 42 (70.0%) | | |
| Spouse's occupation | | | | |
| Higher managerial | 8 (21.1%) | 5 (8.3%) | | |
| Lower managerial | 9 (23.7%) | 20 (33.3%) | | |
| Intermediate occupations | 4 (10.5%) | 2 (3.3%) | | |
| Small employers and own account workers | 6 (15.8%) | 12 (20.0%) | | |
| Lower supervisory and technical occupations | 2 (5.3%) | 9 (15.0%) | 8.053 (7) | 0.328 |
| Semi-routine occupations | 2 (5.3%) | 3 (5.0%) | | |
| Routine occupations | 4 (10.5%) | 6 (10.0%) | | |
| Never worked and long-term unemployed | 3 (7.9%) | 3 (5.0%) | | |
| Where did you get the info about pneumococcal diseases? | | | | |
| Family | 12 (10.0%) | 10 (5.9%) | | |
| Friends | 16 (13.3%) | 30 (17.8%) | | |
| Print media | 9 (7.5%) | 14 (8.3%) | | |
| Electronic media | 16 (13.3%) | 33 (19.5%) | NA | NA |
| Social media | 24 (20.0%) | 35 (20.7%) | | |
| Private clinic | 26 (21.7%) | 23 (13.6%) | | |
| Government clinic | 12 (10.0%) | 22 (13.0%) | | |
| Others | 5 (4.2%) | 2 (1.2%) | | |
| Which sources of information would influence your decision-making regarding vaccination with PCV? | | | | |
| Family | 20 (20.6%) | 23 (18.4%) | | |
| Friends | 18 (18.6%) | 22 (17.6%) | | |
| Print media | 7 (7.2%) | 6 (4.8%) | | |
| Electronic media | 5 (5.2%) | 10 (8.0%) | NA | NA |
| Social media | 11 (11.3%) | 28 (22.4%) | | |
| Private clinic | 24 (24.7%) | 18 (14.4%) | | |
| Government clinic | 10 (10.3%) | 15 (12.0%) | | |
| Others | 2 (2.1%) | 3 (2.4%) | | |

a Independent t-test