

Women's knowledge of maternal danger signs during pregnancy: findings from a cross-sectional survey in Papua New Guinea

Abstract

Objective: to explore knowledge of pregnancy related danger signs among women attending antenatal clinics in Papua New Guinea.

Design: cross-sectional survey undertaken as part of a wider integrated health and demographic survey.

Setting: three sites in Papua New Guinea: Hiri District (Central Province), Karkar (Madang Province) and Asaro (Eastern Highlands Province).

Participants: 482 women aged 15-44 years.

Findings: Almost all (95.2%; 459/482) women attended for antenatal care at least once; 68.2% attended four or more times. Among women who attended the antenatal clinic, 53.6% (246/459) reported receiving information about danger signs in pregnancy from a health worker. Of these 60.2% (148/246) could recall at least one danger sign. In addition, 16.4% (35/213) of women who did not receive information from the antenatal clinic reported pregnancy related danger signs. Among the 183 women who reported danger signs, 47.5% (87/183) reported fever; 39.3% (72/183) reported vaginal bleeding and 36.6% (67/183) reported swelling of the face, legs and arms. Women who reported receiving information at the antenatal clinic were significantly more likely know any danger signs, compared with women who did not receive information at the antenatal clinic (OR 7.68 (95%CI: 4.93, 11.96); $p < 0.001$). Knowledge of danger signs was significantly associated with secondary school education, compared with none or only primary education (OR 3.08 (95% CI: 2.06, 4.61); $p < 0.001$).

Conclusions and implications for practice: every antenatal clinic visit should be used opportunistically to provide women with information about key danger signs during pregnancy and childbirth. Recognising maternal danger signs, together with the importance of seeking early transfer to the health facility and the importance of attending for a health facility birth are critical to improving outcomes for mothers and babies especially in low income settings such as Papua New Guinea.

Key words

Danger signs; pregnancy; antenatal care;

Introduction

Women living in low income countries, in remote areas, and those with low socio-economic status and limited access to care are the least likely to receive adequate care during pregnancy and childbirth, and have the highest maternal and neonatal mortality rates (Darmstadt, Lee et al. 2009). Globally, most maternal deaths are due to direct complications during pregnancy, including haemorrhage, obstructed labour, infections, pregnancy related hypertension and unsafe abortion (WHO 2004, Kassebaum, Bertozzi-Villa et al. 2014, Say, Chou et al. 2014). Indirect causes such as malaria, anaemia, diabetes and mental health disorders also contribute indirectly to maternal deaths (Say, Chou et al. 2014). Key factors to avoid maternal deaths, including access to comprehensive antenatal care, the importance of giving birth with skilled health personnel and access to emergency obstetric care are well documented and supported by recommendations from the World Health Organization (WHO) (Lassi, Haider et al. 2010, Lassi, Das et al. 2014, Lassi, Kumar et al. 2014, Lassi, Mansoor et al. 2014, WHO 2016, WHO 2018).

Globally, women are more likely to attend for antenatal care than to give birth with skilled health personnel, however there are huge disparities between low-middle income and high-income settings (UNICEF 2017). Worldwide, 86% of women attend antenatal care at least once during their pregnancy and 62% attend at least four times (UNICEF 2017). In low-middle income settings, the uptake of antenatal care is 79% and 46% for one and four visits, respectively. Until recently, four antenatal visits was the recommended minimum number of visits to provide adequate antenatal care. However in 2016, in the light of new evidence, particularly for women in low-middle income settings, the WHO recommendations were revised to a minimum of eight visits during the pregnancy (WHO 2016).

Uptake for care during childbirth, supported by skilled health personnel, is also lower among women in the lowest income countries, with just 56% giving birth supported by skilled health personnel, compared to 99% in the highest income countries and 78% globally (UNICEF 2017). Factors for not attending health facilities, or having skilled health personnel in low-resource settings are well documented and include women's lack of capacity in decision making (Allendorf 2007, Mrisho, Schellenberg et al. 2007, Magoma, Requejo et al. 2010, Sychareun, Hansana et al. 2012); cultural and customary beliefs, geographical, socio-economic barriers, and limited access to health facilities (Thaddeus and Maine 1994, Danforth, Kruk et al. 2009). Births that take place unassisted by skilled health personnel, often at home in rural and remote settings, create huge challenges in the efforts to reduce maternal mortality, especially if complications develop during labour and birth or in the postnatal period (Miller, Lester et al. 2004). Significant delays can occur between the onset or identification of a complication and seeking and receiving appropriate health care. In addition to the socio-economic and physical factors associated with reaching a health facility (Thaddeus and Maine 1994, Mrisho, Schellenberg et al. 2007, Magoma, Requejo et al. 2010), delays due to a lack of knowledge in recognising a problem can have an impact on the outcome of both the pregnant woman and/or her unborn infant (Thaddeus and Maine 1994, Karoshi and Keith 2009).

Antenatal care provides a unique opportunity to inform pregnant women of the dangers associated with pregnancy and childbirth, in addition to encouraging women to attend for health facility births. A number of studies from low-resource settings have shown an association between women having knowledge of obstetric danger signs during pregnancy and childbirth (Hailu, Gebremariam et al. 2010, Karkee, Baral et al. 2014, Bogale and Markos 2015, Maseresha, Woldemichael et al. 2016) and -attending for a , health facility birth. In 2015, Bogale et al identified a positive association between information about danger signs received during routine antenatal and knowledge of danger signs (Bogale and Markos 2015). Awareness of danger signs, is among the key recommendations for a positive pregnancy experience, included within the package of birth preparedness and complication readiness (Soubeiga, Gauvin et al. 2014, WHO 2016).

The most common danger signs during pregnancy include severe vaginal bleeding, swollen hands/ face and blurred vision. Major signs during labour and childbirth include severe vaginal bleeding, prolonged labour, convulsions and retained placenta. During the postpartum period major danger signs are severe vaginal bleeding, foul smelling discharge and fever (JHPIEGO 2004, WHO 2006, Hailu, Gebremariam et al. 2010). Women's knowledge of such danger signs is important not only to encourage and promote the utilization of skilled care during childbirth but awareness of obstetric danger signs enables them to seek care and support from health care providers at a health facility, reducing their risk of pregnancy and childbirth complications (WHO 2004).

Papua New Guinea (PNG), a low-middle income setting in the Asia-Pacific region (WorldBank 2015), is a country rich in geographic, social, cultural and linguistic diversity; and is one of the world's most dispersed and rural nations, with many remote and inaccessible communities (UNDP and GoPNG 2014). Eighty seven percent (87%) of the 8.3 million people who live in PNG reside in rural and remote areas (UNFPA 2017). Accessibility to many areas is logistically challenging due to the mountainous terrain of the highlands and the remoteness of 600 islands scattered along the coastline. The remoteness and geographical difficulties can make access to, and uptake and availability of, health care difficult, particularly for women seeking skilled care during pregnancy and childbirth (Vallely, Homiehombo et al. 2013, Vallely, Homiehombo et al. 2015).

The majority of formal health services in PNG are provided through government and church health facilities with nurses, midwives and community health workers (a cadre of specifically, formally trained and regulated health care worker, who undertake a two year training programme within a recognised college), comprising 91% of the medical and nursing workforce (WHO and NDoH 2012). In 2012, there were an estimated 1,800 nurses and 293 midwives working in maternal and infant health in PNG and almost 300,000 births annually (UNFPA, ICM et al. 2014). In rural areas, health services are provided through rural hospitals, health centres or community health posts which provide a range of curative and preventive services, including antenatal and intrapartum care. Due to the limited availability of trained nurses and midwives, much of the

maternal and child health activities in rural areas are carried out by community health workers, with limited training in antenatal, labour and postnatal care.

In PNG, locally written and produced standard management manuals are provided for all health workers to guide specific areas of health care, for example obstetrics and gynaecology, paediatrics and sexually transmitted infections. The obstetrics and gynaecology manual includes education about danger signs, in particular vaginal bleeding, severe headaches and loss of liquor without any contractions, as a key aspect of antenatal care for all women (Mola 2016).

PNG has one of the highest maternal mortality ratios (MMR) in the world with estimates of between 594 and 733 maternal deaths per 100,000 live births (NDoH 2009, Kassebaum, Bertozzi-Villa et al. 2014). This high and possibly increasing MMR is likely due to deteriorating rural health services, poor uptake of and access to available health services and significant health workforce shortages (NDoH 2009). It is estimated that 66% of women attend for antenatal care at least once during pregnancy (NDoH 2014) and 55% attend at least four times (UNICEF 2017); 44% attend for a health facility birth (NDoH 2014). Cultural and geographical diversity are reported as barriers to the availability, access and uptake of skilled and respectful care during pregnancy and childbirth (NDoH 2009, Vallely, Homiehombo et al. 2013, Vallely, Homiehombo et al. 2015).

Between 2010 and 2017, the PNG Institute of Medical Research coordinated the Exxon-Mobil PNG Liquefied Natural Gas Partnership in Health Project (PiHP). One of the overarching aims of the program was to monitor the impact of the PNG- Liquefied Natural Gas project on the health of the population by establishing demographic and health surveillance sites in four locations, two intervention sites (Hiri District and Hides) and two non-intervention sites (Asaro and Karkar). Hiri District, in Central province, is situated to the west of Port Moresby, the Capital of PNG. Despite road access to Port Moresby, basic services are lacking and infrastructure is poor throughout the district (Nguyen, Phuanakoonnon et al. 2014). Situated in Hela province in the Highlands, Hides is a remote, rural location with difficult terrain and access and poor infrastructure. Asaro, is situated approximately 40km from Goroka, the capital of the Eastern

Highlands Province. Although the main Highlands road passes through the area, access to health facilities remains challenging due to poor infrastructure and access to villages. Karkar Island, in Madang province, is situated 30km off the north-west coast of PNG. One road circumnavigates the island, with access to the interior mainly by foot (Nguyen, Phuanukoonnon et al. 2014).

An Integrated Health and Demographic Surveillance System (iHDSS) established in each of the four sites provided the platform to identify all pregnant women, or those who had recently given birth. Within the iHDSS we conducted a maternal and infant health survey with overall aims to: (i) identify barriers in accessing maternal and child health services and; (ii) provide insight into cultural beliefs, practices and experiences surrounding pregnancy, childbirth and the early postnatal period. The aim of this paper was to explore knowledge of danger signs relating to pregnancy among women who attended antenatal care.

Methods

This cross-sectional MIH survey has been described in an earlier paper (Emori, Vallely et al. 2017a). Briefly, the survey was conducted among 482 women aged 15-44 years in three sites: Hiri District (Central), Karkar (Madang) and Asaro (Eastern Highlands). One site (Hides, Hela Province) was excluded from the MIH survey due to security concerns at the time the study was conducted. Women were purposively recruited if they had given birth since 2010, or if they reported being pregnant at the most recent demographic update (2012-2013). Data collection took place between September 2013 and May 2014.

Women willing to participate in the survey were visited in the community by a trained and experienced female member of the research team. Consent was obtained following completion of study-specific informed consent procedures. Participants were interviewed in *Tok Pisin* (one of the three national languages in PNG) using a piloted, study-specific semi-structured questionnaire. Developed by members of the sexual and reproductive health team and the PiHP team at the PNG Institute of Medical Research, the questionnaire was based on data collection tools used in other studies within the

Institute. Questions relating to specific aspects of care during antenatal visits were based on PNG national guidelines (Mola 2016). Maternal danger signs during pregnancy were based on recommended guidelines (WHO 2006). Interviews took place in the women's own home, unless requested that it be undertaken elsewhere. Each interview took between 20 and 40 minutes to complete.

All surveys were completed using an assigned identity number. No participant names or other identifiers were recorded or stored in the same database as the completed survey forms. All surveys were entered into a Microsoft Access database by trained members of the PiHP data entry team. Data were cleaned by the data manager and data queries resolved before data extraction into a Microsoft Excel database. The dependent variable - knowledge of danger signs - was defined when a woman mentioned at least one or more of key danger signs listed on the survey (vaginal bleeding, swelling (legs, feet, hands), headache and dizziness, fever, fits, baby not moving, other (open response)).

Data were summarised as frequencies and percentages. Fisher's Exact Test was used to compare statistical differences between knowledge of danger signs and key variables of interest, including place of residence, parity, age, education level and location of birth and frequency of antenatal visits. Odds ratios were estimated with 95% confidence intervals. Data were analysed using Stata IC v14.0 (StataCorp LP, Texas, USA).

This study was approved by the Medical Research Advisory Committee (MRAC10.17) of the National Department of Health in Papua New Guinea.

Findings

Across the three sites, 541 women were identified as being eligible: Hiri (200); Karkar (216) and Asaro (125), among whom 482 women (89%) were surveyed: Hiri (173); Karkar (204) and Asaro (105). Fifty nine women (11%; 59/541) were excluded due to their decision not to participate, lack of the iHDSS study identity number or incomplete data collection.

Background characteristics

Sociodemographic and pregnancy characteristics of the 482 women are described in an earlier paper (Emori, Vallely et al. 2017a). Briefly, 63.9% (297/465) were aged 15-29 years, 92.7% (447/482) were married and 88.9% (428/482) reported their occupation as housewife/carrying out household duties. Almost all women had received some education (96.5%; 465/482) among whom 66.0% (307/465) had received only primary level education.

Just over half of all women (57.0%; 275/482) had last given birth within two years of our survey (2012-2014). Most women (95.2%; 459/482) attended antenatal care at least once during their last pregnancy; and 68.2% (313/459) reported that they had attended four or more times. Almost two-thirds (64.5%; 311/482) gave birth at a health facility, either a health centre or hospital. Among the women who gave birth unattended by a skilled health provider in the community (i.e. at home), 56.5% (96/170) had been unable to reach or access a health facility to give birth (Emori, Vallely et al. 2017b).

Most women attended a health centre for their antenatal care (82.6%; 379/459) and 56.2% (258/459) received their care from a community health worker (Table 1). Among the 459 women who attended antenatal clinic, 29.0% (133/459) were primiparous. Among the 326 multiparous women, parity ranged from para two to eight. Information relating to knowledge of danger signs was only available for the 459 women who attended antenatal clinic.

Knowledge of danger signs in pregnancy

Almost half (43.1%; 198/459) of the women said they knew danger signs associated with pregnancy.

Just over half (53.6%; 246/459) reported receiving information about danger signs relating to pregnancy from a health worker at the antenatal clinic, among whom 60.2% (148/246) could recall any danger signs (Figure 1). The remaining 213 (46.4%) women stated that they did not receive antenatal education relating to danger signs, however, 16.4% (35/213) could name some danger signs (Figure 1).

Facility attended for last antenatal clinic (n=459)		Health care provider at last antenatal visit (n=459)	
Health centre or community health post	379 (82.6%)	Community health worker	258 (56.2%)
Hospital	47 (10.3%)	Nurse	127 (27.7%)
Not known	33 (7.2%)	Midwife	27 (5.8%)
		Health extension officer	5 (1.1%)
		Doctor	25 (5.4%)
		Not known	17 (3.7%)

Table 1: Facility and care provider last antenatal clinic (n=459)

Among the 183 women who specified danger signs, 58.5% (107/183) knew two or more (Table 2). A total of 329 danger signs were mentioned (Table 3). Fever was the most frequently mentioned danger sign (47.5%), followed by bleeding in pregnancy (39.3%), swelling of the legs/ arms (36.6%) and headaches and dizziness (27.9%) (Table 3).

Women who received information at the antenatal clinic were significantly more likely to know any danger signs compared with women who did not receive any information (60.2% vs. 16.4%; OR 7.78; 95%CI: 4.9, 11.9; $p < 0.001$; Table 3). Those who had received information at the antenatal clinic were significantly more likely to report vaginal bleeding in pregnancy (OR 4.94; 95%CI: 1.82, 13.49; $p < 0.001$) as a danger sign, compared with women who did not receive information at the antenatal clinic (Table 3). There were no significant differences between the two groups of women for knowledge of other specific danger signs, including fever, swelling of limbs and face, headaches and dizziness, reduced fetal movements or fits (Table 3).

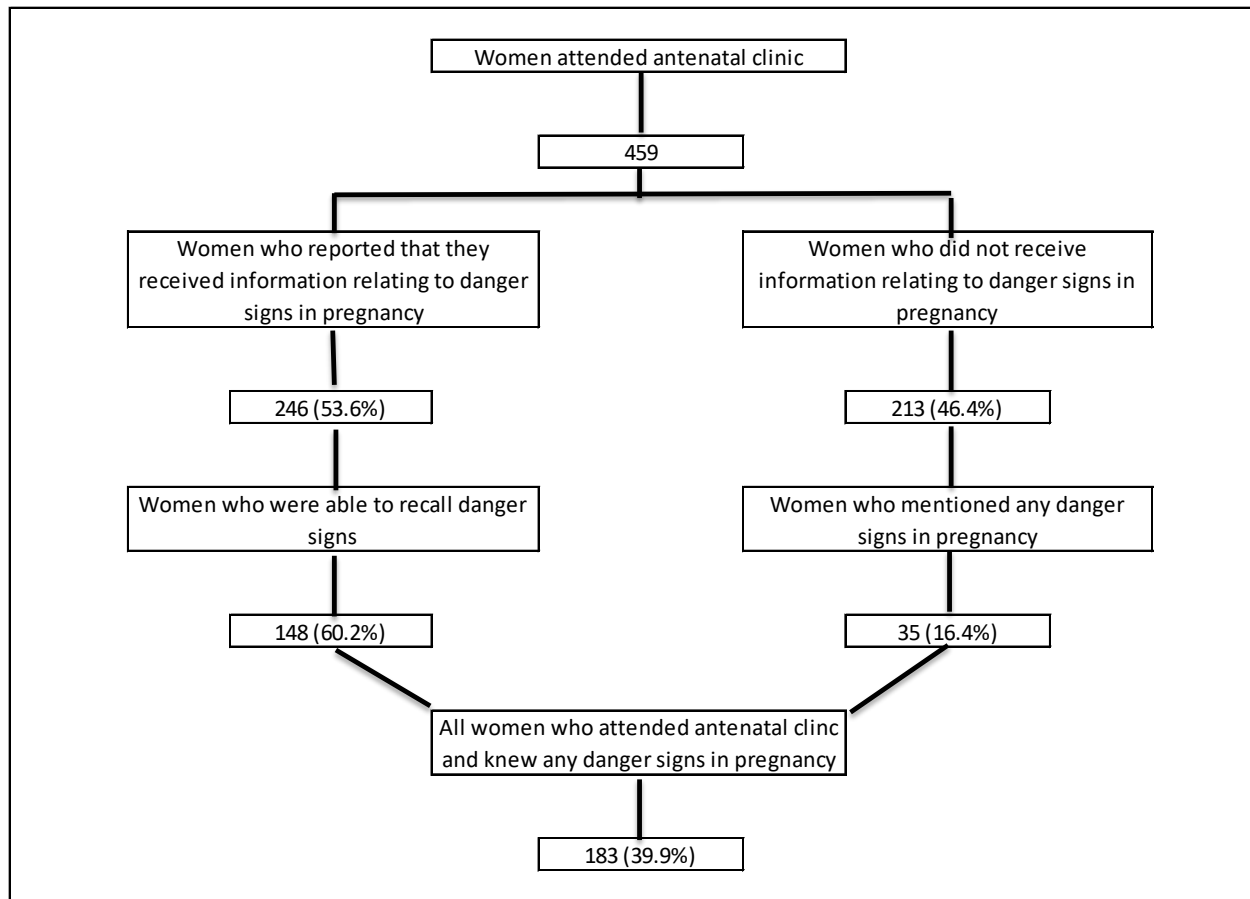


Figure 1: Women reporting that they received information relating to danger signs

Women from Hiri district were five times (OR 5.13; 95%CI: 3.52, 8.00; $p < 0.001$) more likely to know any danger signs, compared with women from Asaro or Karkar.

Knowledge of danger signs was significantly associated with secondary and tertiary education, compared with women having no education or primary education only (OR 3.08; 95%CI: 2.06, 4.61; $p < 0.001$; Table 4). There was no significant association with parity (multiparous compared with primiparous), age (under 24 years compared with age 25 and over), location of birth (health facility birth compared with village birth) or attendance at antenatal clinic (one visit compared with 4 or more), and knowledge of danger signs (Table 4).

	Could recall messages from antenatal clinic N=148/246				Did not receive messages from antenatal clinic but knew danger signs N= 35/213				Total 183/459
	Total N (%)	Asaro N (%)	Hiri N (%)	Karkar N (%)	Total N (%)	Asaro N (%)	Hiri N (%)	Karkar N (%)	N (%)
Any danger signs	148 (60.2)	20 (13.5)	93 (62.8)	35 (23.6)	35 (16.4)	6 (17.1)	17 (48.6)	12 (34.2)	183 (39.9)
One danger sign	58 (39.2)	14 (66.7)	29 (31.9)	15 (40.6)	18 (51.4)	5 (83.3)	6 (35.3)	7 (58.3)	76 (41.5)
Two danger signs	58 (39.2)	3 (16.7)	44 (40.3)	11 (31.3)	10 (28.6)	1 (16.6)	7 (41.2)	2 (16.7)	68 (37.6)
Three or more danger signs	32 (21.6)	3 (16.7)	20 (27.8)	9 (28.1)	7 (20.0)	0 -	4 (23.5)	3 (25.0)	39 (21.3)

Table 2: Number of danger signs known among all women (N=459)

	Total N=459 (%)	Received education about danger signs at antenatal clinic N=246 (%)	Did not receive education about danger signs at antenatal clinicN=213 (%)	OR (95% CI) p value
Any knowledge of danger signs	183 (39.9)	148 (60.2)	35 (16.4)	7.68 (4.93, 11.96) p<0.001
Fever	87 (47.5)	72 (48.6)	15 (42.9)	1.26 (0.60,2.65) p=0.57
Bleeding in pregnancy	72 (39.3)	67 (45.3)	5 (14.3)	4.94(1.82,13.49) p<0.001
Swelling (legs, feet, hands)	67 (36.6)	53 (35.8)	14 (40.0)	0.84 (0.39,1.78) p=0.69
Headache /dizziness	51 (27.9)	40 (27.0)	11 (31.4)	0.81 (0.36,1.79) p=0.67
Baby not moving	40 (21.9)	34 (23.0)	6 (17.1)	1.44 (0.55,3.76) p=0.11
Fits	8 (4.4)	6 (4.1)	2 (5.7)	0.69 (0.13, 3.61) p=0.64
Other*	4 (2.2)	3 (2.01)	1 (2.8)	0.70 (0.07, 6.93) p=0.57
Total number of danger signs reported	329	275	54	

* high blood pressure (1); abdominal pain (2); UTI (1)

Table 3: Pregnancy-related danger signs mentioned

	Asaro N = 100		Hiri N =171		Karkar N = 188		All sites N =459		OR (95% CI) p value
	n	%	n	%	n	%	n	%	
Knew any danger signs	26	26.0	110	64.3	47	25.0	183	39.9	5.13 (3.52, 8.00) p<0.001
Parity									
Multiparous	22	84.6	80	72.7	36	76.6	138	75.4	1.43 (0.94,2.18) p=0.094
Primiparous	4	15.4	30	27.3	11	23.4	45	24.6	
Location of birth									
Health facility birth	21	80.8	79	71.8	32	68.1	132	72.1	1.47 (0.98,2.20) p=0.681
Village birth	5	19.2	31	28.1	15	31.9	51	27.9	
Education level									
Secondary or tertiary	3	11.5	75	68.2	13	27.7	91	49.7	3.08 (2.06,4.61) p =<0.001
None/ primary education	23	88.5	35	31.8	34	72.3	92	50.3	
Age	n=22		n=110		n=46		n=178		
15-24 years	6	27.3	31	28.2	15	32.6	52	29.2	0.66 (0.44,1.00) p=0.053
25 or older	16	72.3	79	71.8	31	67.4	126	70.8	
Not known	(4)	-	-	-	(1)	-	(5)	-	
Antenatal attendance	n=22		n=107		n=46		n=175		
Once	1	4.5	5	4.7	1	2.2	7	4.0	0.71 (0.45,1.10) p=0.152
Twice	1	4.5	6	5.6	4	8.7	11	6.3	
Three times	3	13.6	15	14.0	5	10.9	23	13.1	
Four or more times	17	77.3	81	75.7	36	72.3	134	76.6	
Not known	(4)	-	(3)	-	(1)	-	(8)	-	

Table 4: Factors associated with knowledge of danger signs

Discussion

The majority of women who participated in this survey had attended antenatal care at least once during their most recent pregnancy and more than two thirds had attended four or more times. Just over half of these women reported receiving information relating to maternal danger signs from the antenatal clinic staff. Overall 39.9% (183/459) of women were aware of danger signs during pregnancy, with bleeding and fever the most frequently reported danger signs. Women who had been informed about danger signs at the antenatal clinic and those who had received secondary education were significantly more likely to know any danger signs.

Similar to other settings, in PNG the proportion of women who attend for antenatal care is typically higher than for a health facility birth (NDoH 2014, UNICEF 2017). In 2013, the year this survey was designed, 64% of women in PNG attended antenatal clinic at least once but only 43% of women gave birth in a health facility (NDoH 2014). As described in our earlier work, our survey identified higher rates than the national figure for uptake of antenatal care and health facility births (Emori, Vallely et al. 2017a, Emori, Vallely et al. 2017b) with 95% of women reporting attending for antenatal care and 67% reporting a health facility birth. The higher rates of health facility births in our study may be a reflection of the higher attendance at antenatal clinic, a finding identified in other settings in both PNG and elsewhere (Kerber, de Graft-Johnson et al. 2007, Maraga, Namosha et al. 2011), or due to health messaging during the antenatal clinic (Emori, Vallely et al. 2017a).

The high uptake of antenatal care, at least for one visit (UNICEF 2017) provides an ideal opportunity to promote improved maternal and newborn health outcomes (WHO 2016). The contact between the health care provider and the pregnant woman should be used to its full potential with messages relating to danger signs and advice relating to the importance of giving birth in a health facility. In PNG there are clearly established guidelines to support obstetric care, including routine antenatal care, however, as presented in our earlier work, women often do not receive the full range of antenatal care in these settings (Emori, Vallely et al. 2017a). Reasons for this may be due to broader health systems issues, including lack of equipment and supplies, and logistical

and infrastructure challenges, in addition to poor in-service training and support across all cadres of health workers (NDoH 2009). In our study most women attended a health centre for their antenatal care, and received antenatal care from community health workers. Although only 53.6% of women reported receiving messages relating to danger signs, 80.6% did report being advised to attend a health facility to give birth (Emori, Vallely et al. 2017a).

Knowledge of maternal danger signs is critical to prevent delays in initiating seeking care at a health facility (Ekwochi, Ndu et al. 2015). Among women in our study who knew any danger signs during pregnancy, 39.9% knew at least one danger sign, findings that are consistent with a number of studies from Africa. In Tanzania, 26% of 1118 women knew danger signs in pregnancy (Pembe, Urassa et al. 2009); in Ethiopia 32% of 179 women reported danger signs (Hailu, Gebremariam et al. 2010). Other settings have reported higher rates of knowledge of danger signs: from Uganda Kabakyenga et al report 52% of 764 women (Kabakyenga, Ostergren et al. 2011) mentioned danger signs; and a recently published study from Madagascar reports 81% of 326 women knew at least one danger sign in pregnancy (Salem, Lacour et al. 2018). In our study we identified that knowledge of danger signs was significantly associated with having attended secondary school. This finding has been noted in Tanzania (Pembe, Urassa et al. 2009), however other studies have identified an association between secondary education and knowledge of danger signs in the newborn and postnatal period, but not during pregnancy (Hailu, Gebremariam et al. 2010, Bogale and Markos 2015, Salem, Lacour et al. 2018).

Similar to that reported by Hailu et al (Hailu and Berhe 2014), we did not identify any association between knowledge of danger signs and parity or number of antenatal visits. In our study we did not ask specifically about danger signs during childbirth, however in our earlier paper we report women's knowledge of newborn danger signs (Emori, Vallely et al. 2017b).

The specific danger signs mentioned by women in our study are similar to those from other low-middle income settings. Vaginal bleeding in pregnancy was mentioned consistently in a number of studies reporting danger signs during pregnancy (Hailu and

Berhe 2014, Maseresha, Woldemichael et al. 2016, Bintabara, Mpembeni et al. 2017, Salem, Lacour et al. 2018), including in our study. Swelling of the hands, feet and hands was also identified among women in Ethiopia (Hailu and Berhe 2014, Maseresha, Woldemichael et al. 2016) and headaches and dizziness identified in rural Madagascar (Salem, Lacour et al. 2018). Although not identified as a danger sign directly relating to maternal outcomes, a number of studies, including ours, identified reduced fetal movement as a danger sign (Hailu and Berhe 2014, Maseresha, Woldemichael et al. 2016, Salem, Lacour et al. 2018).

The high rates of uptake of antenatal care and supervised birth in the study sites may be due to ongoing surveillance in the areas, or due to recall bias. We did not corroborate any of the information gained from the women with their hand-held antenatal clinical records. This cross-sectional survey collected self-reported data relating to women's last birth experience. We attempted to limit recall bias from self-reports by interviewing women who had given birth recently (within the previous three years). In our study we found significantly greater knowledge of danger signs among women who received information at antenatal clinic, and among women with secondary education. Women from Hiri were more likely to have received secondary education, compared with women from Asaro and Karkar. Hiri is a peri-urban district, compared to Asaro and Karkar, which are predominantly rural. This may explain the increased level of education and subsequent knowledge among women in Hiri.

Conclusion

In this setting, 60% of women did not have any knowledge of danger signs relating to pregnancy despite 76% of women attending for antenatal care four or more times. Despite hectic workloads and limited resources, health care workers need to harness the opportunity of the antenatal clinic to provide women with information on the importance of recognising danger signs during pregnancy and the importance to seek professional, skilled care promptly should problems arise.

References

- Allendorf, K. (2007). "Couples' reports of women's autonomy and health-care use in Nepal." *Studies in family planning* 38(1): 35-46.
- Bintabara, D., R. N. M. Mpembeni and A. A. Mohamed (2017). "Knowledge of obstetric danger signs among recently-delivered women in Chamwino district, Tanzania: a cross-sectional study." *BMC Pregnancy Childbirth* 17(1): 276.
- Bogale, D. and D. Markos (2015). "Knowledge of obstetric danger signs among child bearing age women in Goba district, Ethiopia: a cross-sectional study." *BMC Pregnancy Childbirth* 15: 77.
- Danforth, E. J., M. E. Kruk, P. C. Rockers, et al. (2009). "Household decision-making about delivery in health facilities: evidence from Tanzania." *Journal of Health, Population and Nutrition* 27(5): 696-703.
- Darmstadt, G. L., A. C. Lee, S. Cousens, et al. (2009). "60 Million non-facility births: who can deliver in community settings to reduce intrapartum-related deaths?" *Int J Gynaecol Obstet* 107 Suppl 1: S89-112.
- Ekwochi, U., I. K. Ndu, C. D. Osuorah, et al. (2015). "Knowledge of danger signs in newborns and health seeking practices of mothers and care givers in Enugu state, South-East Nigeria." *Ital J Pediatr* 41: 18.
- Emori, R., A. Vallely, H. Gouda, et al. (2017a). "Women's recall of uptake and provision of antenatal care in Papua New Guinea: findings of a maternal and infant health survey conducted in three provinces." *PNG Med J* 60(1-2): 15-26.
- Emori, R., A. Vallely, H. Gouda, et al. (2017b). "Supervised and unsupervised birth and early newborn care practices in Papua New Guinea: Findings of a maternal and infant health survey conducted in three provinces." *PNG Med J* 60(1-2): 27-40.
- Hailu, D. and H. Berhe (2014). "Knowledge about obstetric danger signs and associated factors among mothers in Tsegedie district, Tigray region, Ethiopia 2013: community based cross-sectional study." *PLoS One* 9(2): e83459.
- Hailu, M., A. Gebremariam and F. Alemseged (2010). "Knowledge about Obstetric Danger Signs among Pregnant Women in Aleta Wondo District, Sidama Zone, Southern Ethiopia." *Ethiop J Health Sci* 20(1): 25-32.
- JHPIEGO (2004). *Monitoring birth preparedness and complication readiness: tools and indicators for maternal and newborn health*. Maryland, USA, Jhpiego.
- Kabakyenga, J. K., P. O. Ostergren, E. Turyakira, et al. (2011). "Knowledge of obstetric danger signs and birth preparedness practices among women in rural Uganda." *Reprod Health* 8: 33.
- Karkee, R., O. B. Baral, V. Khanal, et al. (2014). "The role of obstetric knowledge in utilization of delivery service in Nepal." *Health Educ Res* 29(6): 1041-1048.
- Karoshi, M. and L. Keith (2009). "Challenges in managing postpartum hemorrhage in resource-poor countries." *Clinical obstetrics and gynecology* 52(2): 285-298.
- Kassebaum, N. J., A. Bertozzi-Villa, M. S. Coggeshall, et al. (2014). "Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013." *Lancet* 384(9947): 980-1004.
- Kerber, K. J., J. E. de Graft-Johnson, Z. A. Bhutta, et al. (2007). "Continuum of care for maternal, newborn, and child health: from slogan to service delivery." *Lancet* 370(9595): 1358-1369.

- Lassi, Z. S., J. K. Das, R. A. Salam, et al. (2014). "Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings." *Reprod Health* 11 Suppl 2: S2.
- Lassi, Z. S., B. A. Haider and Z. A. Bhutta (2010). Community-based intervention packages for reducing maternal and neonatal morbidity and mortality and improving neonatal outcomes. . *Cochrane Database of Systematic Review*.
- Lassi, Z. S., R. Kumar, T. Mansoor, et al. (2014). "Essential interventions: implementation strategies and proposed packages of care." *Reprod Health* 11 Suppl 1: S5.
- Lassi, Z. S., T. Mansoor, R. A. Salam, et al. (2014). "Essential pre-pregnancy and pregnancy interventions for improved maternal, newborn and child health." *Reprod Health* 11 Suppl 1: S2.
- Magoma, M., J. Requejo, O. Campbell, et al. (2010). "High ANC coverage and low skilled attendance in a rural Tanzanian district: a case for implementing a birth plan intervention." *BMC pregnancy and childbirth* 10(1): 13.
- Maraga, S., E. Namosha, H. Gouda, et al. (2011). "Sociodemographic factors associated with maternal health care utilization in Wosera, East Sepik Province, Papua New Guinea. ." *PNG Med J* 54: 154-163.
- Maseresha, N., K. Woldemichael and L. Dube (2016). "Knowledge of obstetric danger signs and associated factors among pregnant women in Erer district, Somali region, Ethiopia." *BMC Womens Health* 16: 30.
- Miller, S., F. Lester and P. Hensleigh (2004). "Prevention and treatment of postpartum hemorrhage: new advances for low-resource settings." *J Midwifery Womens Health* 49(4): 283-292.
- Mola, G., Ed. (2016). *Manual of standard management in obstetrics and gynaecology for doctors, Health Extension Officers and nurses in Papua New Guinea*. Port Moresby.
- Mrisho, M., J. A. Schellenberg, A. K. Mushi, et al. (2007). "Factors affecting home delivery in rural Tanzania." *Tropical Medicine and International Health* 12(7): 862-872.
- NDoH (2009). *Ministerial Task Force on Maternal Health in Papua New Guinea*. Waigani, Papua New Guinea, National Department of Health.
- NDoH (2014). *National Health Information Systems: Sector Performance Annual Review 2013*. N. D. o. Health. Waigani, Papua New Guinea, Government of Papua New Guinea.
- NDoH (2014). *National Health Plan 2011-2020: 2014 Sector Performance Annual Review*. Port Moresby, Papua New Guinea., National Department of Health
- Nguyen, B., S. Phuanukoonnon, H. Gouda, et al. (2014). *Progress Report Partnership in Health project January 2014- June 2014*. Goroka, PNG, PNG Institute of Medical Research.
- Pembe, A. B., D. P. Urassa, A. Carlstedt, et al. (2009). "Rural Tanzanian women's awareness of danger signs of obstetric complications." *BMC Pregnancy Childbirth* 9: 12.
- Salem, A., O. Lacour, S. Scaringella, et al. (2018). "Cross-sectional survey of knowledge of obstetric danger signs among women in rural Madagascar." *BMC Pregnancy Childbirth* 18(1): 46.
- Say, L., D. Chou, A. Gemmill, et al. (2014). "Global causes of maternal death: a WHO systematic analysis." *Lancet Glob Health* 2(6): e323-333.
- Soubeiga, D., L. Gauvin, M. A. Hatem, et al. (2014). "Birth Preparedness and Complication Readiness (BPCR) interventions to reduce maternal and neonatal mortality in developing countries: systematic review and meta-analysis." *BMC Pregnancy Childbirth* 14: 129.

Sychareun, V., V. Hansana, V. Somphet, et al. (2012). "Reasons rural Laotians choose home deliveries over delivery at health facilities: a qualitative study." *BMC Pregnancy Childbirth* 12(1): 86.

Thaddeus, S. and D. Maine (1994). "Too far to walk: maternal mortality in context." *Soc Sci Med* 38(8): 1091-1110.

UNDP and GoPNG (2014). National Human development report. From Wealth to Wellbeing: Translating Resource Revenue into Sustainable Human Development. Port Moresby, Papua New Guinea, United Nations Development Program.

UNFPA. (2017). "World Population Dashboard- Papua New Guinea " Retrieved 3rd Sept, 2018, from <https://www.unfpa.org/data/world-population/PG>.

UNFPA, ICM and WHO (2014). The State of the Worlds Midwifery. A universal pathway. A woman's right to health. New York, United Nations.

UNICEF (2017). State of the World's Children 2017: Children in a digital world.

Vallely, L. M., P. Homiehombo, A. Kelly-Hanku, et al. (2015). "Childbirth in a rural highlands community in Papua New Guinea: a descriptive study." *Midwifery* 31(3): 380-387.

Vallely, L. M., P. Homiehombo, A. Kelly, et al. (2013). "Exploring women's perspectives of access to care during pregnancy and childbirth: A qualitative study from rural Papua New Guinea." *Midwifery* 29(10): 1222-1229.

WHO (2004). Beyond the numbers: Reviewing maternal deaths and complications to make pregnancy safer. Geneva, World Health Organization.

WHO (2004). Making pregnancy safer: the critical role of the skilled attendant. A joint statement bt WHO, ICM & FIGO. Geneva, Making Pregnancy Safer: Department of Reproductive Health and Research.

WHO (2006). Pregnancy, Childbirth, Postpartum and Newborn Care: A guide for essential practice. Geneva, World Health Organization.

WHO (2016). WHO recommendiosn for a positive pregnancy experience. Geneva, WHO.

WHO (2018). Definition of skilled health personnel providing care during childbirth: the 2018 joint statement by WHO, UNFPA, UNICEF, ICM, ICN, FIGO and IPA. Geneva, World Health Organization.

WHO and NDoH. (2012). "Health Service delivery profile Papua New Guinea ", from http://www.wpro.who.int/health_services/service_delivery_profile_papua_new_guinea.pdf.

WorldBank. (2015). "World Bank Country Profiles: Papua New Guinea." Retrieved April, 2015, from <http://www.worldbank.org/en/country/png>.