Original Research Article

Maternal and fetal outcomes in the absence of antenatal care: a retrospective cohort study

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ABSTRACT

Background: Antenatal care plays a pivotal role in prevention, detection and treatment of pregnancy-related complications and in improving maternal and perinatal outcomes. However, few studies focus on higher income countries and no local studies have been done. This study aims to investigate these outcomes in unbooked pregnancies locally.
Methods: We conducted a retrospective single-centre cohort study of unbooked pregnant women presenting between January 2015 to December 2019. We compared indicators of maternal and perinatal outcomes between the unbooked group and women receiving routine antenatal care. Modified Poisson regression was used to test the relationship between the booking status of the pregnancy and various outcome indicators.
Results: 50,163 women delivered in the centre, 3% (n=1,525) of whom were unbooked. Unbooked women were more likely to have emergency caesarean sections and were at greater risk of delivering low birth weight babies, requiring blood transfusions (adjusted risk ratio (aRR) 2.59, CI 2.17-3.1; p<0.001) and had a 3.74-time risk of intensive care unit (ICU) admissions (CI 2.53-5.52; p<0.001). The maternal mortality rate was roughly 6 per 100,000 live births in the general population compared to 64.3 per 100,000 for the unbooked population.
Conclusions: Although the proportion of unbooked pregnancies are low, these women are more likely to have poorer outcomes and are at increased risk of neonatal morbidity and mortality. Our study highlights the importance of regular antenatal care amongst those at most risk of complications. More work is required to explore reasons for non-engagement to encourage uptake of ANC in this population.

Keywords: Prenatal care, Maternal health services, Perinatal mortality

INTRODUCTION

The basis of regular antenatal care (ANC) is the provision of opportunities for identifying women at risk of developing complications and to detect early signs of disease to allow institution of preventative measures and timely intervention. According to the World Health Organisation (WHO), the following are essential interventions in ANC - identification and management of obstetric complications such as preeclampsia, immunisation, intermittent preventive treatment for malaria during pregnancy in endemic areas, and identification and management of infections including HIV, syphilis and other sexually transmitted infections (STIs). Indeed, studies conducted globally have found ANC received from skilled providers reduces the risk of pregnancy complications and adverse pregnancy outcomes such as stillbirths, intrauterine growth restriction, preterm births, fetal anomalies and other fetal complications. This is thought to be mediated through health promotion, disease prevention, screening and treatment which increases maternal and newborn survival. ANC is hence an

important component of the WHO's every woman every child movement. Timeliness of ANC has also been identified as essential in ensuring healthy pregnancy outcomes.[1-3]

It stands to reason that this would hold true globally. However, there has been no local data and few published studies in developed countries published regarding the lack of antenatal care and the subsequent impact on maternal and neonatal outcomes. Most studies are focused on lower income countries with different population demographics and therefore with differing healthcare considerations. For example, while nutritional deficiencies are a big problem in lower income countries; Singapore, like many other developed countries is more focused on the opposite problem of increasing obesity rates. This study is thus aimed at studying maternal and perinatal outcomes in unbooked pregnancies presenting to our centre to see if the importance of ANC holds true.

METHODS

We conducted a retrospective single-centre cohort study of unbooked pregnant women presenting to KK Women's and Children's Hospital (KKWCH), Singapore's largest maternity facility between January 2015 to December 2019. An unbooked pregnancy was defined as a pregnancy during which women had not visited a healthcare professional throughout their pregnancy prior to presentation at our delivery suite. All labour and delivery information was recorded and subsequently entered into the hospital database at the point of delivery by the medical team. Deidentified information from the database from January 2015 to December 2019 was reviewed, selecting for indicators of maternal and perinatal outcomes. We compared indicators of maternal and perinatal outcomes between the unbooked group and women receiving routine antenatal care. Singleton and multiple pregnancies were analysed separately. Modified Poisson regression was used to test the relationship between the booking status of the pregnancy and the mode of delivery, blood transfusions, maternal intensive care unit (ICU) admissions, birth weight, neonatal ICU (NICU) admission, intrauterine death and neonatal death. Demographic

factors such as age and ethnicity were taken into account and the results were adjusted, as necessary. The level of statistical significance was set at p value <0.05. Statistical analysis was performed with Stata 13.0 version 13.0 (StataCorp, College Station, Texas 77845 USA).

Important obstetric complications such as pre-eclampsia and antepartum haemorrhage are entered as free text under the antenatal and intrapartum complications domain in the database. For all unbooked patients, the free text was exported and manually searched through to determine the incidence of these complications. An institutional review board waiver was obtained (ref no.: 202011-00063) for this study.

RESULTS

Within the study period, 50,163 women delivered in KKWCH, 3% (n=1,525) of whom were unbooked. Demographics of the study population are summarised in Table 1. The average age of women in the general population was 30.6, similar to the unbooked group where the average age was 30.1. Majority of both groups were aged 21-34 although teenage pregnancies were significantly more common in the unbooked population (5.4% versus 2.9%; adjusted risk ratio (aRR) 1.90 p<0.001). Unbooked women were significantly more likely to be smokers (10.7% versus 5%), unmarried (12.3% versus 3.1%), of non-Chinese and non-Indian race (58.5% versus 47.2%) and multiparous (66.1% versus 57.6%); with a 5-time increased risk of grandmultiparity (CI 4-6.26; p<0.001). They were also less often overweight (34.7% versus 40.1%) or obese (31.5% versus 33.6%).

Unbooked women with a singleton pregnancy were more likely to have a vaginal breech (aRR 4.38; CI 2.07-9.3; p<0.001) or emergency caesarean delivery (aRR 1.17; CI 1.07-1.28; p=0.001) compared to the general population (Table 2). In comparison, unbooked women with a multiple pregnancy were less likely to have a planned elective caesarean (aRR 0.5; CI 0.27-0.94; p=0.031) than the general population but there was no significant difference between the other modes of delivery (Table 3).

Table 1: Demographics of study population.

Variables	General population (%)	Unbooked population (%)	P value
Age (in years)			
≤20	1394/48638 (2.9)	83/1525 (5.4)	<0.001
21-34	36297/48638 (74.6)	1106/1525 (72.5)	
35-39	9048/48638 (18.6)	265/1525 (17.4)	
≥40	1899/48638 (3.9)	71/1525 (4.7)	
BMI			
<18.5	127/21008 (0.6)	3/340 (0.9)	
18.5 ≤BMI <25	5405/21008 (25.7)	112/340 (32.9)	
25 ≤BMI <30	8419/21008 (40.1)	118/340 (34.7)	0.002

Continued.

Variables	General population (%)	Unbooked population (%)	P value
≥30	7057/21008 (33.6)	107/340 (31.5)	0.019
Mother race			
Chinese	20204/48637 (41.5)	512/1525 (33.6)	
Malay	12501/48637 (25.7)	477/1525 (31.3)	<0.001
Indian	5459/48637 (11.2)	117/1525 (7.7)	
Others	10473/48637 (21.5)	419/1525 (27.5)	<0.001
Smoker status			
Yes	1007/20124 (5.0)	36/337 (10.7)	<0.001
No	19117/20124 (95.0)	301/337 (89.3)	
Marital status			
Married	43677/45098 (96.9)	1231/1414 (87.1)	
Single	1019/45098 (2.3)	135/1414 (9.6)	<0.001
Divorced/widowed/others	402/45098 (0.9)	48/1414 (3.4)	<0.001
Parity			
0	20129/47513 (42.4)	508/1497 (33.9)	
1-4	26795/47513 (56.4)	909/1497 (60.7)	<0.001
≥5	589/47513 (1.2)	80/1497 (5.3)	<0.001

Table 2: Outcomes in singleton pregnancies in general population versus unbooked population.

Outcome indicators	Risk ratio (95% CI*)	P value	Adjusted risk ratio (95% CI)	P value
MOD				
NVD	Reference			
Assisted delivery	0.46 (0.35-0.61)	<0.001	0.5 (0.37-0.66)	<0.001
Breech vaginal delivery	4.22 (2.01-8.83)	<0.001	4.38 (2.07-9.3)	<0.001
Elective CS	0.27 (0.2-0.36)	<0.001	0.3 (0.22-0.39)	<0.001
Emergency CS	1.15 (1.05-1.26)	0.003	1.17 (1.07-1.28)	0.001
Blood transfusion				
No	Reference			
Yes	2.72 (2.28-3.25)	< 0.001	2.59 (2.17-3.1)	<0.001
ICU admission				
No	Reference			
Yes	3.71 (2.51-5.46)	< 0.001	3.74 (2.53-5.52)	<0.001
Blood loss (ml)				
<500	Reference			
≥500 and <1000	1.05 (0.88-1.25)	0.583	1.06 (0.89-1.26)	0.527
≥1000	1.94 (1.34-2.82)	<0.001	1.93 (1.33-2.80)	<0.001
Birth weight				
Normal birth weight	Reference			
Extremely low birth weight	12.1 (9.22-15.9)	<0.001	13.47 (10.16-17.87)	<0.001
Very low birth weight	10.22 (8.12-12.87)	<0.001	11.15 (8.79-14.14)	<0.001
Low birth weight	3.02 (2.74-3.33)	<0.001	3.04 (2.75-3.35)	<0.001
Macrosomia	1.08 (0.69-1.7)	0.733	1.04 (0.66-1.64)	0.854
NICU admission				
No	Reference			
Yes	1.13 (0.81-1.59)	0.476	1.12 (0.8-1.57)	0.516
Intrauterine death				
No	Reference			
Yes	5.28 (3.37-8.26)	<0.001	5.29 (3.35-8.36)	<0.001
Neonatal death				
No	Reference			
Yes	5.55 (3.01-10.22)	<0.001	5.47 (2.93-10.19)	<0.001

*CI: confidence interval

Table 3: Outcomes in multiple pregnancies in general population versus unbooked population.

Outcome indicators	Risk ratio (95% CI*)	P value	Adjusted risk ratio (95% CI)	P value
MOD				
NVD	Reference			
Assisted delivery	0.73 (0.11-4.89)	0.749	0.69 (0.09-5.01)	0.710
Breech vaginal delivery	1.66 (0.44-6.22)	0.451	1.61 (0.44-5.87)	0.472
Elective CS	0.49 (0.26-0.91)	0.024	0.5 (0.27-0.94)	0.031
Emergency CS	0.98 (0.85-1.12)	0.761	1.00 (0.86-1.15)	0.984
Birth weight				
Normal birth weight	8.98 (5.84-13.81)	<0.001	10.85 (6.15-19.13)	<0.001
Extremely low birth weight	3.25 CI (1.91-5.53)	<0.001	3.00 (1.79-5.01)	<0.001
Very low birth weight	1.34 CI (1.21-1.5)	<0.001	1.35 (1.2-1.51)	<0.001
Low birth weight	Reference			
Macrosomia	-	-	-	-
NICU admission				
No	Reference			
Yes	1.19 (0.16-8.58)	0.866	1.09 (0.15-7.82)	0.930
Intrauterine death				
No	Reference			
Yes	3.2 (0.42-24.59)	0.264	3.09 (0.4-23.55)	0.277
Neonatal death				
No	Reference			
Yes	2.91 (0.38-22.16)	0.303	2.17 (0.29-16.18)	0.450
Blood transfusion				
No	Reference			
Yes	1.92 (0.85-4.37)	0.118	1.88 (0.86-4.12)	0.116
ICU admission				
No	Reference			
Yes	2.49 (0.34-18.37)	0.372	2.65 (0.32-21.74)	0.364
Blood loss (ml)				
<500	Reference			
≥500 and <1000	0.84 (0.49-1.43)	0.510	0.85 (0.50-1.45)	0.549
≥1000	1.02 (0.27-3.89)	0.972	1.00 (0.27-3.79)	0.996

*CI: confidence interval

While the difference in minor postpartum haemorrhage (PPH) (blood loss ≥500 ml and <1000 ml) did not reach statistical significance, there was a statistically significant increased risk of major PPH in unbooked women with singleton pregnancies (blood loss ≥1000 ml) (aRR 1.93; CI 1.33-2.80; p<0.001). The unbooked singleton group were also more than twice as likely to require blood transfusions (aRR 2.59; CI 2.17-3.1; p<0.001) and 3.74 times more likely to be admitted to ICU (CI 2.53-5.52; p<0.001). There was no significant difference in these risks amongst the multiple pregnancy groups. There was a total of 4 maternal deaths in this period, one of whom was unbooked, which translates to a maternal mortality rate of roughly 6 per 100,000 live births in the general population compared to 64.3 per 100,000 in the unbooked population.

In terms of fetal outcomes, birth weight was used as a proxy for both prematurity and growth restriction. Gestations of the pregnancies were not available in the unbooked women as last menstrual periods could not be reliably obtained from the unbooked group. Within the unbooked group, 32.4% of singletons and 92.9% of multiple pregnancies had low birth weights as compared to 9.3% and 70.2% respectively in the general population. Low birth weights were further subclassified according to the WHO definition where low birth weight (LBW) refers to babies born weighing less than 2500 g, very low birth weight (VLBW) being less than 1500 g and extremely low birth weight (ELBW) being less than 1000g. There were statistically significant increases in risks of LBW (aRR 3.04 CI 2.75-3.35; p<0.001), VLBW (aRR 1.15 CI 8.79-14.14; p<0.001) and ELBW (aRR 13.47 CI 10.16-17.87; p<0.001) babies born to unbooked mothers. In unbooked multiple pregnancies, the adjusted risk ratios were 1.35 (CI 1.2-1.51; p<0.001), 3.00 (CI 1.79-5.01; p<0.001), and 10.85 (CI 6.15-19.13; p<0.001 respectively.

While there was no significant observed difference in the risk of NICU admissions (aRR 1.12; CI 0.8-1.57; p=0.516), there was a 5-fold increased risk of both intrauterine (aRR 5.29; CI 3.35-8.36; p<0.001) and

neonatal death (aRR 5.47; CI 2.93-10.19; p<0.001) amongst the unbooked singleton babies. There was no significant difference in risks of NICU admissions or intrauterine or neonatal death in the multiple pregnancy groups.

In our study, hypertensive disorders of pregnancy affected 5.3% of unbooked pregnancies, with 1.4% of women having pregnancy induced hypertension (PIH) and 3.9% affected by pre-eclampsia (PE). 1.4% of unbooked women suffered from antepartum haemorrhage and 0.3% from placental abruption.

DISCUSSION

Data collection was stopped after December 2019 to eliminate the confounding effects of the COVID-19 pandemic on ANC uptake. The results of our study show increased risk of adverse outcomes in the unbooked group across most outcome indicators, with increased rates of blood transfusions, maternal ICU admissions, low birth weight babies, intrauterine and neonatal mortalities. This is consistent with studies conducted in other developed countries; Linard et al showed in a French cohort that severe maternal morbidity was associated with a consultation rate of less than half the recommended visits and forgoing any component of ANC was associated with severe perinatal morbidity.[3]

Undiagnosed and unmanaged obstetric conditions contribute to increased maternal morbidity and mortality not to mention poor neonatal outcomes. A large retrospective observational study conducted across all United States counties by Moaddab et al identified only 6 risk factors that were significantly (p<0.05) associated with maternal mortality ratio; attending four or less prenatal visits and gestational diabetes being amongst those.[4] Bouvier-Colle et al also reported a higher risk of maternal ICU admission amongst women with no antenatal care, consistent with our observation of a statistically significant 3.7-fold increase in risk of ICU admissions.[5] These associations may reflect the importance of regular ANC to screen for pathologies and institute appropriate management which can reduce the risks of resultant morbidity and mortality. Our subset analysis of prevalence of complications in the unbooked population is likely to underestimate the true prevalence as data entry for free text fields may be inconsistent. Our study showed a low 0.3% prevalence of placental abruption in unbooked pregnancies, much lower than another cohort study demonstrating a rate of 4.44% and 6.28% in women who did not or under-attended ANC respectively.[6] Pre-existing medical conditions increase the risks of complications but this was not captured in our study due to the retrospective nature of the data. While this potentially confounds the correlations, the aforementioned studies observed a significant difference even after adjusting for maternal risk levels, suggesting that engagement with ANC may be associated with lower risks of complications.

Increased rates of blood transfusions were seen in both the singleton and multiple pregnancy unbooked groups although the latter did not reach statistical significance. We hypothesize that untreated maternal anemia could be an underlying factor in this. Iron and folate deficiencies are associated with anaemia which is estimated to affect 38.2% of pregnant women globally, with the highest prevalence in South-East Asia (48.7%).[7] Through ANC, women are screened for anaemia and can access appropriate micronutrient supplementation to correct this, possibly accounting for the reduced blood transfusions in the control group.

A Finnish study by Raatikainen et al demonstrated a 1% rate of non-attendance of ANC and 0.77% rate of under-attenders, comparable to the 3% non-attendance rate in our study although under-attendance was not assessed. It was similarly observed by the Finnish group that non-attenders and under-attenders significantly more often had preterm births and delivered LBW infants.[6] Herbst et al also reported that LBW babies were 1.8-fold more common with no ANC, although our study suggests an even greater 3-fold risk of this.[8]

More smokers were observed in the unbooked group in our study which is consistent with other studies showing that smoking status was statistically significantly associated with non or under engagement with ANC.[6,9] However, data on smoking status was not available in a significant number of patients.

The unbooked singleton group was more likely to deliver via vaginal breech or emergency caesarean section and less likely to have an assisted delivery or elective caesarean. Majority of unbooked women (68.4%) with multiple pregnancies delivered via emergency caesarean section. We postulate that it is likely more unbooked women present emergently or in advanced labour explaining this pattern of mode of deliveries.

The reasons for women defaulting ANC in Singapore is not well evaluated. However, studies have been done in other developed countries investigating this. A study led by Blondel et al evaluating 20 French districts found a 1.1% rate of poor ANC attenders and found that lack of health insurance was a risk factor for underattendance. Most teenage mothers in the study also reported that they received little or no care because they were unaware, they were pregnant, did not want the pregnancy or wanted to hide their situation from their family.[10] Bekemeier et al evaluated this in the United States and similarly described financial barriers, failure to recognise pregnancy symptoms, unwanted pregnancy, and fear of parental response as barriers to ANC. They additionally noted that childcare issues, difficulties obtaining appointments, long distances from care settings and lack of transportation to clinics as aspects affecting engagement with ANC.[11]

Women of young age, high parity, low socio-economic status, low education levels or belonging to a minority

ethnic group are more likely to default ANC.[3,12,13] Although there is universal healthcare in Singapore, co-payments are required. Hence financial constraints likely contribute to lack of uptake of care. Direct and indirect costs such as transport and loss of income respectively are also relevant. The view that pregnancy is a normal state which does not require medicalisation is another factor that emerges across studies.[12,14] Delving further into the motivations behind women forgoing ANC would thus be vital in improving ANC services and increasing uptake to achieve better obstetric and neonatal outcomes.

The strength of this study lies in its large sample size. Although only a single-centre study, KKWCH is the largest maternity facility in Singapore, providing care for over 14,000 obstetric patients every year, equivalent to about one-third of the country's total births, improving the generalisability of our study.[15]

However, being the largest, and one of only three public obstetric hospitals in Singapore could lead to over-representation of underprivileged women, who are more likely to present to a public service. This could result in skewing of the study results. As the data is keyed manually by the medical team, it is subject to errors of transposition and transcription. Omissions in data collection were also noted, particularly with regards to demographic data. This hampers analysis of our results, potentially affecting the representativeness of our sample.

However, as these omissions were deemed to be missing at random, we deemed the risk of bias to be low and analysed the individual demographic data applying listwise deletion. Causative relationships also cannot be assumed due to the retrospective and observational nature of the study.

CONCLUSION

Results from our study, which is the first of its kind exploring this issue in Singapore, indicate that maternal and neonatal outcomes are significantly worse in the unbooked population as compared those receiving regular ANC, suggesting that it is pivotal in reducing morbidity and mortality for both the woman and her baby. Our study highlights the importance of provision of regular antenatal care amongst groups at most risk of complications such as young single mothers. Reasons for defaulting ANC are multi-faceted and nuanced involving deeper societal and economic factors. Therefore, further work, including a prospective study of this group of women is needed to tease out these motivations to allow strategic enhancement of our existing services. A collaborative multi-agency effort is necessary to tackle this problem starting from a grassroots level to improve uptake of ANC to consequently reduce complications and poor outcomes in this vulnerable group.

REFERENCES

1. Tunçalp, Pena-Rosas JP, Lawrie T, Bucagu M, Oladapo OT, Portela A, et al. WHO recommendations on antenatal care for a positive pregnancy experience-going beyond survival. BJOG An Int J Obstet Gynaecol. 2017;124(6):860-2.
2. Sarker BK, Rahman M, Rahman T, Rahman T, Khalil JJ, Hasan M, et al. Status of the WHO recommended timing and frequency of antenatal care visits in Northern Bangladesh. PLoS One. 2020;15(11):1-21.
3. Linard M, Blondel B, Estellat C, Deneux-Tharaux C, Luton D, Oury JF, et al. Association between inadequate antenatal care utilisation and severe perinatal and maternal morbidity: an analysis in the PreCARE cohort. BJOG An Int J Obstet Gynaecol. 2018;125(5):587-95.
4. Moaddab A, Dildy GA, Brown HL, Bateni ZH, Belfort MA, Sangi-Haghpeykar H, et al. Health Care Disparity and State-Specific Pregnancy-Related Mortality in the United States, 2005-2014. Obstet Gynecol. 2016;128(4):869-75.
5. Bouvier-Colle MH, Varnoux N, Salanave B, Ancel PY BG. Case-control study of risk factors for obstetric patients' admission to intensive care units. Eur J Obs Gynecol Reprod Biol. 1997;74:173-7.
6. Raatikainen K, Heiskanen N, Heinonen S. Under-attending free antenatal care is associated with adverse pregnancy outcomes. BMC Public Health. 2007;7:1-8.
7. World Health Organisation. WHO Recommendations on antenatal care for a positive pregnancy experience. 2016. Available at: https://www.who.int/publications/i/item/9789241549912. Accessed on 10 December 2023.
8. Herbst MA, Mercer BM, Beazley D, Meyer N, Carr T. Relationship of prenatal care and perinatal morbidity in low-birth-weight infants. Am J Obstet Gynecol. 2003;189(4):930-3.
9. Kapaya H, Mercer E, Boffey F, Jones G, Mitchell C, Anumba D. Deprivation and poor psychosocial support are key determinants of late antenatal presentation and poor fetal outcomes-a combined retrospective and prospective study. BMC Pregnancy Childbirth. 2015;15(1):1-9.
10. Blondel B, Marshall B. Poor antenatal care in 20 French districts: Risk factors and pregnancy outcome. J Epidemiol Community Health. 1998;52(8):501-6.
11. Bekemeier B, Grembowski D, Yang YR, Herting JR. Local public health delivery of maternal child health services: Are specific activities associated

with reductions in black-white mortality disparities? Matern Child Health J. 2012;16(3):615-23.

12. Downe S, Finlayson K, Walsh D, Lavender T. "Weighing up and balancing out": A meta-synthesis of barriers to antenatal care for marginalised women in high-income countries. BJOG An Int J Obstet Gynaecol. 2009;116(4):518-29.

13. Kim MK, Lee SM, Bae SH, Kim HJ, Lim NG, Yoo SJ, et al. Socioeconomic status can affect pregnancy outcomes and complications, even with a universal healthcare system. Int J Equity Health. 2018;17(1):2.

14. Downe S, Finlayson K, Tunçalp Ö, Am G. Provision and uptake of routine antenatal services: a qualitative evidence synthesis. Cochrane Database Syst Rev. 2019;(6):CD012392.

15. KK Women's and Children's Hospital. Obstetrics Clinical Outcomes. 2018. Available at: https://www. kkh.com.sg/about-kkh/corporate-profile/clinical-outcomes/Pages/obstetrics.aspx. Accessed on 10 December 2023.