**Maternal morbidity: a longitudinal study of women’s health during and up to 22 months after pregnancy in Jamaica**

### Abstract

The sustainable development goals aim to improve health and well-being for all. Our study sought to evaluate factors associated with ill-health in women during and after pregnancy. A population-based longitudinal study of women who delivered a singleton live-born baby in a 3-month period across Jamaica was conducted. Socio-demographic factors, perception of health, chronic illnesses and frequency and reasons for hospital admission were assessed during pregnancy; within 24-48 hours after birth; up to 12 months and up to 22 months after childbirth. This study presents data for women participating in all four assessments. Relationships between ill-health and maternal characteristics were estimated using log-normal regression analysis. Of 9,742 women interviewed at birth, 1,311 were assessed at all four stages, 27.7% of whom reported ill-health at least once. Hospitalization rates were 20.9% during pregnancy, 6.1% up to 12 months and 0.5% up to 22 months after childbirth. Complications related to pregnancy accounted for 69.3% of antenatal admissions. Ill-health, reported by 11% of women, was less likely with better education (RR=0.62, 95%; 0.42-0.84). Hospital admission was associated with a higher socio-economic status (RR=1.33, 95% 1.04-1.70) and delivery by Caesarean section [CS] (RR=1.57, 95%; 1.21-2.04). One in three (33.7%) women recorded ongoing chronic illnesses after childbirth. These were more likely with an increase in age and parity and was associated with delivery by elective CS (RR=1.44, 95%; 1.20-1.73). In multivariable analyses, ill-health was more likely with chronic illness (RR=2.06, 95%; CI: 1.71-2.48) and hospital admission from 12 to 22 months after childbirth (RR=1.54, 95% CI: 1.12-2.12). Ill-health during pregnancy and after childbirth represent a significant burden of disease. A standardised comprehensive approach to measuring and addressing this disease burden will ensure that women and their babies survive and thrive during and after pregnancy.

Keywords: indicators, maternal morbidity, pregnancy, postnatal, assessment.

Short Title:Maternal morbidity during pregnancy and up to 22 months after birth.

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### **Introduction**

While maternal mortality has been decreasing in many settings globally, the burden of morbidity or ill-health is significant and may be underestimated, with chronic non-communicable diseases (NCDs) becoming proportionately more important (G.B.D. Study, 2013). While the causes of maternal deaths have become clearer, the concept and true magnitude of underlying maternal morbidity is poorly understood (Liskin, 1992). Much research on maternal morbidity to date has focused on life threatening, severe acute maternal morbidity or ‘maternal near miss’, which has been well defined and usually assessed at secondary or tertiary care levels (Mantel, et. al., 1998; Pattinson, et. al, 2009).

In contrast, morbidity which is not immediately life threatening, but experienced as ill-health by the woman during or after pregnancy or noted by her healthcare provider, because it impairs her wellbeing or is associated with adverse perinatal outcome, is less well documented (Zafar, et.al., 2015). Non-severe maternal morbidity, has been defined as ‘any condition attributed to or aggravated by pregnancy and childbirth which has a negative impact on the woman’s wellbeing and functioning’ (Firoz, et al, 2013). This is in line with the concept of health as ‘a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity’ (W.H.O., 1948). To date, there is little information, regarding how women perceive or report ill-health during pregnancy and after childbirth, especially in low-and middle-income countries (LMIC) where the burden of disease is expected to be highest.

In Australia, women were asked 2-4 weeks after childbirth to rate their health as excellent, very good, good, fair or poor. When responses were collapsed into a dichotomous variable of better (excellent, very good, good) or worse (fair, poor), 4.0% perceived their health as worse. This negative rating was associated with financial and social challenges and emotional distress (Morgan & Eastwood, 2014). In Lebanon, 13.1% of women rated their health as poor after childbirth (Abdulrahim, & El Asmar, 2012). A multi-country study of 11,454 women across four LMIC settings found that while most women reported good satisfaction with health and good quality of life, 9.0% had an identified infectious disease (HIV, malaria, syphilis, chest infection or tuberculosis), 47.9% were anaemic, and 11.5% were diagnosed with other medical or obstetric morbidity. In addition, 25.1% of women screened positive for a psychological morbidity and 36.6% reported social morbidities such as exposure to violence and substance misuse (McCauley, et.al. 2018). Another study of three LMICs found that at least 30% of women suffer some form of morbidity during and after pregnancy (Barreix, et.al. 2018).

The new Sustainable Development Goal three (SDG 3) aims to ‘ensure healthy lives and promote well-being for all at all ages’ and has been associated with a new international priority to ensure that every woman, including pregnant women, have an equal chance not only to ‘survive, but to thrive’ (U.N., 2015; U.N. & W.H.O., 2015). There is thus a need to understand and document better the health needs of women during, immediately, and more long-term, after pregnancy. Furthermore, it is important to develop methods and tools to comprehensively assess and document health status, and where possible, identify indicators or markers that can be used as proxy measures for the burden of ill-health not considered life-threatening or severe, but which is nevertheless of significance.

Our primary objective was to explore the self-reported health status of women who were assessed during pregnancy, after childbirth and up to 22 months after childbirth, as experienced and reported by women themselves. As a secondary objective we assessed the number and reasons for hospital admission at each stage of pregnancy, the presence of underlying chronic illness, and the effect of socio-economic status (SES) and education on health. Finally, we examined if hospital admissions or presence of chronic illness could be considered proxy indicators for non-severe maternal morbidity.

### **Materials and Methods**

### Study design

Data on the health status of women during and after pregnancy were collected as part of the second Jamaican Birth Cohort Study (JA KIDS), a population-based observational study to investigate health, developmental and behavioural outcomes for livebirths occurring from July 1-September 30, 2011. The methodology of the study is published elsewhere (JA KIDS 2011). In brief, mothers of these children were assessed during pregnancy (after 28 weeks gestation) and 24–48 hours after childbirth. Efforts were made to follow up all mothers within 9-12 months of childbirth and a computer generated random sample (35%) was selected for follow-up when the children were 18-22 months old. For the purposes of this study, data relating only to women delivering singleton live births and assessed at all four stages are presented, n=1,311.

### Participation and refusal rates

Most Jamaican women attend four or more antenatal visits (86%), with 99% of births attended by a skilled health attendant (STATIN, UNICEF, 2011). Of 11,124 women who delivered a live-born baby between July 1 and September 30, 2011 and eligible for the study, 9,742 (87.5%) were assessed within 48 hours of childbirth (5% refusal rate; 7.5% discharged before invitation or too ill to participate). Of these, 4,572 (46.9%) had enrolled during pregnancy. All mothers were interviewed face-to-face using standardized questionnaires by trained interviewers. Questions were mainly closed ended but allowed for recording of options not listed on the schedule.

### Socio-demographic variables

Available demographics include age, number of previous pregnancies and educational level and were assessed during pregnancy and within 48 hours after childbirth. Socio-economic status (SES) was derived using a durable goods index proxy indicator which incorporates demographic variables such as age, previous pregnancies and education level, and information collected on a range of household items. The process employs principal components analysis to place participants in low, medium or high SES. Such indices are commonly used in LMICs where data describing income tends to be incomplete and unreliable (Filmer & Pritchett; 2001).

*Rating of health status*

At birth women were asked to rate their condition on a two-point scale as well (1) or ill (2). During pregnancy and at the two post-childbirth assessments women were asked to rate their health on a five-point scale: excellent (1), very good (2), average (3), fair (4) or poor (5). This latter scale was collapsed to good (1) or poor (2), with a score of ill (2) at birth or fair to poor (4-5) on other occasions considered to represent ill-health (2).

### Obstetric and non-obstetric conditions including chronic diseases

Women were asked to respond (yes/no) to a comprehensive listing of health conditions by health systems including: gastrointestinal, cardiovascular, respiratory, haematological, metabolic, neurological, musculoskeletal, psychological, dermatological, immunological, gynaecological and urogenital; and obstetric conditions such as hypertension, haemorrhage, and infections related to pregnancy and childbirth. In addition, women were asked to provide details on any known chronic illnesses at 9-12 and 18-22 months after childbirth.

### Admissions to hospital

Women were asked about the number and reason for hospital admission during pregnancy, at 9-12 months (since childbirth) and at 18-22 months after childbirth (since child turned one).

### Coding and classification of health conditions and rating of health status

### The WHO ICD-MM classification framework (W.H.O., 2012) was adapted to code the reason for hospital admission as: obstetric (complications related to pregnancy), indirect (non-communicable diseases or infections not related to pregnancy), co-incidental, (intentional or unintentional injuries) or unspecified (not documented). The indirect category was expanded to detail four groups of NCDs (cardio-cerebro-renovascular; haematological and immunological; endocrine and metabolic and other) and two categories of non-obstetric infections (HIV disease and other infections) (McCaw-Binns, et. al., 2018). Responses were coded into clinically relevant categories.

### Statistical analysis

Data analysis was performed using SPSS v21 and Stata v12. P-values were derived using likelihood ratio test; a p-value of <0.05 was considered statistically significant and estimates were derived with 95% confidence intervals. No adjustments for multiple comparisons were used. Relative risks were estimated (for the outcomes of ill-health, hospital admission and chronic illness) using univariable log binomial models for binary variables. Ill-health was also analysed using a multivariable log binomial model with hospital admissions and chronic illness as explanatory variables. Variables statistically significant in univariable analyses (p<0.10) were included in multivariable log-binomial regression analyses.

### **Results**

Of the 9,742 women assessed at least once during or after pregnancy, 79.5% had a normal vaginal birth, 19.4% delivered by caesarean section (CS) (12.3% elective, 7.1% emergency), while less than 0.1% had an instrumental vaginal childbirth. No delivery information was available for 1.4%. Of the 1,311 women assessed at all four stages, their characteristics were similar to those not assessed on all occasions, however those with all four contacts were more likely to have secondary level education or vocational training (**Table 1**). On each follow up occasion (9-12 and 18-22 months) women assessed were less likely to report ill-health than those not assessed (3.0% for those assessed at 9-12 months (p=0.004) and 2.7% for those assessed at 18-22 months (p=0.02) compared, with 3.4% at delivery).Further descriptive analyses are confined to these 1,311 women, who were on average 25.9 (±6.6) years, all literate (7% tertiary education), 23% of whom were classified as low and 19% as high SES.

### **Insert Table 1 here**

### Self-reported health

At each assessment point (n=1,311), between 55.7% and 59.3% of women reported excellent or very good health while up to 3.1% reported poor or ill health. Using the collapsed two-point scale, about one in ten women reported feeling either fair or poor/ill during pregnancy (11.3%), at 9-12 months (11.0%) and at 18-22 months (10.6%). At the four time-points during and after pregnancy 73.4% always reported feeling well, with the remainder reporting ill-health on one or more occasion (19.8% reported ill-health during one of the four points, 5.2% for two and 1.5% for three or more assessment points) (**Figure 1**).

**Insert Figure 1 here**

*Hospital admission*

Admission to hospital was reported by20.9% of women during pregnancy, 6.1% in the first year after childbirth and 0.5% in months 12-22 after childbirth, with 31.0% admitted at some point over the two-year review period (**Table 2**). Of the antepartum admissions (n=349) with details, 274 (78.5%) women were admitted once while 75 (21.5%) required two or more admissions. Of 80 women admitted between childbirth and 9-12 months, 72 (90%) reported one and eight (10%) reported two or more admissions. At 18-22 months, 7 of the 13 women reported just one admission (53.8%). Complications of pregnancy (direct) were the most frequent reason for admissions during pregnancy (68.3%), with 60.8% of these classified as ‘other obstetric complications’ such as threatened preterm labour and pre-labour rupture of membranes **(Table 2**).

**Insert Table 2 here**

### Chronic illness

Women were asked to detail specific chronic illnesses during pregnancy and after childbirth. For the 1,311 women who provided information at all four contact times, similar proportions reported essential hypertension (10.5–9.5%), asthma (4.4-3.2%), diabetes mellitus (1.3-1.0%) and sickle cell anaemia (0.7-0.7%) at the two contacts after childbirth. On both occasions 5.9% of the respondents reported other ‘unspecified conditions’. Women reporting chronic illnesses were older, more likely to have at least one previous pregnancy and to have only completed primary education (**Table 3**).

**Insert Table 3 here**

### Associations between hospital admission, chronic illness and ill-health

Ill-health was less likely as education increased (RR=0.62, 95%; 0.42-0.84). Hospital admission was more likely with a higher SES (RR=1.33, 95% 1.04-1.70) and delivery by emergency CS (RR=1.57, 95%; 1.21-2.04). Maternal assessment of any poor health was not predictive of hospital admission in the two years after childbirth. Economically vulnerable women (primary education, low SES) were more likely to report being unwell than women with higher levels of education and SES. Mode of childbirth was not associated with being unwell but correlated with admission for elective (RR 1.48, 95% CI: 1.21-1.81) and emergency CS (RR 1.57, 95% CI: 1.21-2.04). Women reporting chronic illness were more likely to be delivered by elective CS (RR 1.44, 95% CI: 1.20-1.73). At 9-12 and 18-22 months after childbirth, 24.0% and 20.6% of women reported ongoing chronic illness, which was more likely with an increase in age (RR=2.01 95% CI: 1.41-2.86) and parity (RR=1.49, 95% CI: 1.09-2.04). Ill-health at any time was associated with chronic illness (RR=2.15, 95% CI:1.81-2.57); and admissions antenatally (RR=1.38, 95% CI: 1.14-1.66), during the first 12 months (RR=1.54, 95% CI:1.15-2.05) and between 12-22 months (RR=1.82, 95% CI: 1.30-2.54). In multivariable analyses, ill-health was more likely with chronic illness (RR=2.06, 95% CI: 1.71-2.48) and hospital admission from one year to 22 months after birth (RR=1.54, 95% CI: 1.12-2.12) (**Table 4**).

### **Discussion**

### Principal findings

Of the women assessed at four stages during and after pregnancy in Jamaica, at least 10% reported ill-health in at least at one stage, with a minority (3.1%) reporting ill-health at all four stages. Admission was common during pregnancy with one in four women (26.6%) admitted to a hospital, two-thirds for problems related to the pregnancy. After childbirth, hospital admission rates decreased to 6.1% in the first and 0.8% in the second year after childbirth. Overall, one in three women reported a chronic health condition (33.7%), mainly essential hypertension, asthma and diabetes mellitus, with the risk increasing with age.

### Strengths and weaknesses

To the best of our knowledge, this is the first study in a LMIC to explore women’s self-assessed health, beginning with pregnancy and continuing up to 22 months after childbirth, and explore associated factors such as hospital admission and presence of chronic illness. Women included in this study were compared with women in the larger JA KIDS study and there were little differences in the study populations, suggesting the findings are generalizable to the Jamaican population. This paper only included women with a live singleton birth and may underestimate ill-health associated with stillbirth or multiple pregnancies. This study focussed on women who were assessed at all four assessment contacts and may underestimate ill-health, as ill-health at the time of delivery could reduce the likelihood of a woman participating in both follow-up visits. Furthermore, as JA KIDS excluded women with severe or life-threatening complications around birth, we report only on ill-health or non-severe maternal morbidity. A key strength of this study is the long follow-up period, continuing to 18-22 months after childbirth. While not every woman recruited at each assessment answered every question and around 20% were not assessed at 9-12 months after childbirth, we report on a core group of 1,311 women evaluated at all stages. This ensures we are observing the health status of the same population of women over time.

While the assessment of ill-health reported by women themselves was not ‘verified’ by medical examination, investigations and/or analyses of medical records, our prevalence rate of 10-11% is like findings from other developed and LMIC settings which range from 4% to 15% (Zafar et al, 2015,Morgan & Eastwood, 2014). Self-reported perception or experience of health has been associated with objective clinical measures of morbidity, after controlling for a variety of physical, socio-demographic and psycho-social health indices (Eriksson, et. al., 2001). Furthermore, women’s own experience and reporting of ill-health or non-wellbeing is increasingly being accepted as a valid outcome measure (Zafar et al, 2015; McCauley et al, 2018; Barreix, et al, 2018).

A critical limitation of the lack of clinical examination (e.g. height, weight) was the inability to measure the contribution of obesity or possible malnutrition to maternal morbidity. A 2008 national survey found that 16.5%, 37.7% and 50.5% of non-pregnant Jamaican women 15-24, 25-34 and 35-44 years of age were obese. Underweight was found in 12.6% of 15-24-year olds but only 2.4% of older women (Wilks, et. al., 2012). As the study was not designed to explore perinatal outcome, women with an adverse infant outcome were excluded, restricting our capacity to evaluate the relationship between maternal ill-health and perinatal loss.

We included women who had given birth within 48 hours. We recognise that data collected at this time regarding complications during pregnancy and self-reporting of health may not be very reliable and biased. For example, women who have just had a straightforward vaginal birth may be very happy and may under-report their other problems; whereas women who just had a difficult complication of labour and delivery (although a small component) may overstate the situation. In future studies, it may be considered not to collect such data at this stage, as maternal morbidity that arises because of the pregnancy and persists as a health problem could be better screened for during and after pregnancy.

In our study, some antenatal conditions may be misclassified; for example, vomiting could be classified as an obstetric complication due to hyperemesis or as vomiting secondary due to gastroenteritis and classified as a non-obstetric complication. Furthermore, the data collection process did not distinguish between conditions diagnosed prior to pregnancy from those only identified during or since the index birth. This distinction may be difficult to make in many LMICs however as pre-existing conditions may only get diagnosed when women who consider themselves healthy interact with the health services for the first time during pregnancy.

At the time of writing, there was no internationally agreed framework to classify and code medical conditions that contribute to non-severe maternal morbidity. While adapting the WHO ICD-MM framework (W.H.O., 2012) to maternal morbidity was appropriate and feasible, we recognize that the prevalence of some conditions (e.g. threatened preterm labour) differs remarkably from the major causes of maternal death, and may require expanding the “other obstetric complications” category further. Use of this adapted version of the WHO ICD-MM framework to maternal morbidities needs to be explored in further studies to enable realistic comparisons to be made.

### Meaning of the study

In our study 31.0% of women require hospitalisation at least once during or after pregnancy. Our admission rate during pregnancy (20.9%) is less than that for teenage girls (26.5%) and women aged 20 years or more (31.1%) from a previous study of Jamaican women (Ashley, et.al., 1994). In the USA, the proportion of pregnant women requiring admission was 12.8% in 2000, a decrease from 17.6% in 1991 (Bacak, et.al., 2005). In the UK, the proportion of women requiring antenatal admission ranges from 16.4-22.6% (Sultan, et.al., 2013; Lindquest, et. al., 2014). This constitutes a significant burden for the health system and understanding the reasons for ill-health leading to hospital admission may help develop more comprehensive care packages for use during ‘routine’ antenatal and postnatal care visits that can help reduce this burden. In our study, 21.5% of admitted women required two or more hospital admissions during pregnancy. The reasons for recurrent admission require further investigation as this may indicate recurrent morbidity or inability to manage the first episode of ill-health effectively.

To our knowledge, our study is the first to describe the occurrence of any hospital admission in the first year (6.1%) and up to 22 months childbirth (0.5%), with 10.0% (8/80) and 46.1% (66/13) of women admitted two or more times by 12 months and 22 months respectively. Several studies describe the need and reason for admission in the early postnatal period and up to six weeks after childbirth; with 0.9% of women in the UK readmitted as an emergency within 30 days of childbirth (Sultan, et.al., 2013; Lindquist et.al. 2014) and 1.3% of women readmitted within 6 weeks of childbirth in the Canada (Liu, et.al, 2002). A randomised controlled trial in Switzerland reported a higher rate of readmission (3.5%) in the first six months after home-based care versus 2.2% after hospital-based care (Boulvain, et.al. 2004). However, data on admission up to and after one-year childbirth is limited and primarily addresses mental health. In Australia 1.7% of new mothers were admitted with a mental health diagnosis in the first year after childbirth (Xu, et al; 2014).

The most common reason for admission in the first year was due to sequelae of the hypertensive disorders of pregnancy and this was also the most common self-reported ongoing chronic illness after childbirth. It is unclear whether some are misclassified cases of essential hypertension first diagnosed during pregnancy. Women reporting chronic illness tend to be older, higher parity, more likely delivered by elective CS and/or report ill-health. However, neither hospital admission nor reporting of ill-health are particularly good indicators or proxy markers of perceived maternal morbidity with a likelihood ratio of between 1.4 and 1.8 only.

The documented CS rate (19.4%) for Jamaica exceeds the 15% upper limit recommended by the WHO after which the benefit to mother or neonate cease to exceed the risk (Belfort, et.al., 2010; WHO, 2015). US and Canadian women who had a CS were more likely to be readmitted than after a vaginal birth, with pregnancy-related infections common reasons for readmission within six weeks of birth in women with CS compared to vaginal birth (Bacak, et.al., 2005; Liu, et. al., 2002).

### Unanswered questions

The current challenge is that estimates of non-severe maternal morbidity are not based on standardised, clear and concise definitions and methodology, and thus have limited utility and validity to inform efforts to measure and address the burden of ill-health during and after pregnancy and do not allow comparability across settings. Recent studies demonstrating the need to develop and test a standardized tool holds some promise for the future (McCauley, et.al., 2018; Barreix, et.al., 2018; Ye, et. al., 2015). This will complement existing guidelines for severe maternal morbidity or ‘near misses’ (Chou, et. al., 2016; Say, et. al., 2009).

### **Conclusions**

This longitudinal assessment of maternal health during pregnancy and up to 22 months after childbirth among women delivering singleton livebirths in Jamaica indicates that one in 10 women did not assess their health status favourably during this period; and these women were more likely to be older, socially vulnerable and with a pre-existing chronic health condition. Efforts are needed to promote global use of a standardized tool to measure and understand non-life threatening maternal ill-health co-existing with childbearing. Effective methodologies will benefit the family and the community by safeguarding the chances for both mother and baby to survive and thrive.

### **Author’s contributions**

AMB, MSV and NvdB conceived the study. MM, JAR and NvdB conceived the design of the secondary analysis and inclusion of variables. MM coded variables in the database. JAR cleaned the data and JAR and SW performed data analysis. MM interpreted the data and wrote the manuscript. JAR, SW, AMB, NvdB and MSV edited the manuscript and have approved it for submission.

**Ethical Approval**

Ethical approval to conduct the study was granted by the University of the West Indies Ethics Committee and the Ministry of Health's Advisory Panel on Medico - Legal Affairs in Jamaica.

a scientific paper.

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**Figure 1:** Self-reported assessment of health during pregnancy and up to 22 months after birth (n=1,311)

**Table 1:** Comparison of socio demographic characteristics for all possible women at each assessment point.

|  |  |
| --- | --- |
| **Socio-demographic characteristics**  | **Assessment point** |
| **Within 48 hours after birth** **(n= 9,742)** | **During pregnancy** **(n = 4,576)** | **9-12 months after childbirth** **(n= 7,609)** | **18-22 months after childbirth** **(n = 3,381)** | **Women assessed at all 4 times (n=1,311)**  |
|  |  | Statistic(s) | p-valuea | Statistic(s) | p-valuea | Statistic(s) | p-valuea | Statistic(s) | p-valuea |
| **Total women interviewed (n)** | 9,742 | 4,576 |  | 7,609 |  | 3,381 |  | 1,311 |  |
| **Age (women with data available)** | 9,626 | 3,899 |  | 7,364 |  | 3,246 |  | 1,294 |  |
| **Age (years) at delivery** **[Mean (sd)]**  | 26.3 (8.0) | 25.4 (6.6) | <0.001 | 26.1 (6.7) | 0.30 | 26.2 (6.7) | 0.18 | 25.9 (6.6) | 0.49 |
| **Number of previous pregnancies (women with data available)** | 9,365 | 3,797 |  | 7,178 |  | 3,176 |  | 1,268 |  |
| **Previous pregnancies (**% of women)None | 36.1 | 38.7 | <0.001 | 35.9 | 0.002 | 36.0 | 0.37 | 37.1 | 0.34 |
| One to Four  | 57.6 | 56.1 | 58.2 | 58.1 | 57.3 |
| Five or greater  | 6.4 | 5.3 | 5.9 | 5.9 | 5.5 |
| **Education (women with data available)** | 9,547 | 3,856 |  | 7,301 |  | 3,226 |  | 1,282 |  |
| **Educational Level (**% of women)Primary/Junior High | 20.4 | 21.6 | <0.001 | 19.7 | 0.001 | 18.5 | 0.004 | 18.7 | 0.002 |
| Secondary  | 55.2 | 56.4 | 55.3 | 55.7 | 57.4 |
| Vocational  | 14.8 | 15.5 | 15.4 | 15.6 | 16.5 |
| Tertiary | 9.6 | 6.6 | 9.5 | 10.3 | 7.3 |
| **Socioeconomic Status** **(women with data available)** | 9,742 | 3,944 |  | 7,439 |  | 3,284 |  | 1,311 |  |
| **Socioeconomic Status** (% of women) Low | 24.1 | 24.9 | <0.001 | 24.3 | 0.84 | 24.1 | 0.06 | 23.3 | 0.21 |
| Medium  | 55.2 | 57.8 | 55.1 | 53.9 | 57.4 |
| High | 20.6 | 17.3 | 20.7 | 22.0 | 19.3 |
| **General health assessment after delivery** **(women with data available)** | 9,068 | 3,681 |  | 6,954 |  | 3,077 |  | 1,222 |  |
| Ill-health (% of women)  | 3.4 | 3.3 | 0.77 | 3.0 | 0.004 | 2.7 | 0.02 | 2.9 | 0.35 |
| a for all comparisons, socio-demographic characteristics of women assessed at each assessment point compared to those recruited within 24-48 hours after childbirth but not assessed at each assessment point. |

**Table 2:** Prevalence of hospital admission and cause, coded as per adapted WHO ICD-MM framework.

|  |  |  |  |
| --- | --- | --- | --- |
| Assessment point  | Any hospital admission during pregnancy | Any hospital admission from birth to 12 months post childbirth | Any hospital admission from one year to 22 months post childbirth |
| TOTAL NUMBER OF ADMISSIONS (including repeat admissions)  | 349 | 89 | 13 |
| Number of women admitted at least once | 274 | 80 | 7 |
| Number of admissions with reasons for admission given, including injuries | 347 | 77 | 11 |
| Total number of admissions due to DIRECT obstetric complications | 237  | 54 | 11  |
| Abortive outcome/ Early pregnancy complication  | 3 | 0 | 0 |
| Hypertensive disorders of pregnancy | 67 | 29 | 0 |
| Obstetric haemorrhage | 21 | 1 | 0 |
| Pregnancy related infection | 2 | 19 | 0 |
| Other obstetric complications | 144 | 5 | 11 |
| * Labour / delivery / for CS
 | 11 | 0 | 0 |
| * Abdominal pain / contractions
 | 52 | 4 | 0 |
| * Preterm labour / for cervical suture
 | 21 | 0 | 0 |
| * Rupture of membranes (preterm and term)
 | 6 | 0 | 0 |
| * Foetal / baby wellbeing concerns
 | 9 | 0 | 3 |
| * Back pain
 | 8 | 1 | 0 |
| * Other
 | 737 | 0 | 8 |
| Total number of admissions due to INDIRECT obstetric complications | 101  | 20  | 0 |
| Cardio-cerebro-renovascular conditions | 10 | 13 | 0 |
| Haematological /immunological | 10 | 5 | 0 |
| Endocrine and metabolic | 19 | 1 | 0 |
| Other NCDs | 9 | 0 | 0 |
| HIV disease | 0 | 0 | 0 |
| Other non-obstetric infections | 53 | 1 | 0 |
| INJURIES (intentional/ unintentional) | 9  | 3 | 0 |
| UNSPECIFIED CONDITIONS  | 0 | 0 | 0 |

**Table 3:** Associations between socio-demographic characteristics, ill-health, hospital admission and chronic illness (n=1,311).

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Ill-health at any point** | **Hospital admission at any point** | **Chronic illness reported after childbirth**  |
| **%** | **p-value** | **RR (95% CI)** | **%** | **p-value** | **RR (95% CI)** | **%** | **p-value** | **RR (95% CI)** |
| All women | **27.7** |  |  | **31.0** |  |  | **33.7** |  |  |
| **Age (years)** |
| Overall  |  | 0.72 |  |  | 0.76 |  |  | **<0.001** |  |
| <20 | 27.9 |  |  | 32.1 |  |  | 26.7 |  |  |
| 20-29 | 27.8 |  | 1.00 (0.78-1.27) | 30.1 |  | 0.94 (0.75-1.17) | 31.4 |  | 1.18 (0.92-1.50) |
| 30-39 | 28.3 |  | 1.01 (0.77–1.33) | 31.5 |  | 0.98 (0.76-1.26) | 40.4 |  | 1.51 (1.18-1.94) |
| 40-49 | 20.0 |  | 0.72 (0.37-1.38) | 37.8 |  | 1.18 (0.75-1.85) | 53.7 |  | 2.01 (1.41-2.86) |
| **Number of all previous pregnancies** |
| Overall  |  | 0.17 |  |  | 0.43 |  |  | **0.008** |  |
| None | 25.5 |  |  | 30.4 |  |  | 28.2 |  |  |
| One to Four  | 28.1 |  | 1.10 (0.90-1.34) | 30.0 |  | 0.99 (0.82-1.19) | 35.8 |  | 1.27 (1.06-1.51) |
| Five or greater  | 36.4 |  | 1.42 (1.00-2.04) | 37.7 |  | 1.24 (0.89-1.73) | 42.0 |  | 1.49 (1.09-2.04) |
| **Educational Level** |
| Overall  |  | **0.006** |  |  | 0.90 |  |  | 0.58 |  |
| Primary  | 35.8 |  |  | 32.6 |  |  | 35.2 |  |  |
| Secondary  | 27.4 |  | 0.76 (0.62-0.94) | 31.6 |  | 0.97 (0.78-1.20) | 34.0 |  | 0.97 (0.79-1.18) |
| Vocational  | 21.1 |  | 0.59 (0.38-0.91) | 31.5 |  | 0.97 (0.67-1.38) | 34.4 |  | 0.98 (0.70-1.37) |
| Tertiary | 22.1 |  | 0.62 (0.42-0.84) | 29.3 |  | 0.90 (0.68-1.20) | 29.4 |  | 0.84 (0.64-1.10) |
| **Socioeconomic Status** |
| Overall  |  | 0.71 |  |  | **0.03** |  |  | 0.87 |  |
| Low | 28.6 |  |  | 28.7 |  |  | 34.2 |  |  |
| Medium  | 28.0 |  | 0.98 (0.79-1.21) | 29.6 |  | 1.03 (0.83-1.28) | 33.9 |  | 0.99 (0.82-1.19) |
| High | 25.6 |  | 0.90 (0.68-1.18) | 38.1 |  | 1.33 (1.04-1.70) | 32.3 |  | 0.94 (0.74-1.20) |
| **Mode of childbirth** |
| Overall  |  | 0.14 |  |  | **<0.001** |  |  | **0.003** |  |
| Vaginal | 26.8 |  |  | 28.0 |  |  | 31.7 |  |  |
| Elective CS | 32.8 |  | 1.22 (0.97-1.54) | 41.5 |  | 1.48 (1.21-1.81) | 45.7 |  | 1.44 (1.20-1.73) |
| Emergency CS | 25.3 |  | 0.94 (0.65-1.37) | 44.1 |  | 1.57 (1.21-2.04) | 29.2 |  | 0.92 (0.66-1.29) |
| Missing/other | 57.1 |  | 2.13 (1.11-4.08) | 33.3 |  | 1.19 (0.38-3.71) | 42.9 |  | 1.35 (0.57-3.20) |

**Table 4:** Summary of univariable and multivariable analyses of association between ill-health and hospital admission and chronic illness for women assessed at all four assessment stages (n=1,311).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Number included** | **Ill-health at any assessment point (%)** | **p-value** | **RR (95% CI)** | **Diagnostic accuracy** | **Multivariable analysis** |
| **Sensitivity (95% CI); LR+** | **Specificity (95% CI); LR-** | **p-value** | **RR (95% CI)** |
| **Hospital admission in the antenatal period** |
| No | 939 | 25.6% | **0.002** | **1.0** | 30.0 (25.2, 35.2); 1.40 | 78.7 (75.9, 81.3); 0.89 | 0.07 | **1.0** |
| Yes | 293 | 35.2% | 1.38 (1.14-1.66) | 1.20 (0.99-1.45) |
| **Hospital admission from birth to 12 months post childbirth**  |
| No | 1,134 | 26.9% | **0.009** | **1.0** | 9.2 (6.4, 12.8); 1.83 | 95.0 (93.3, 96.3); 0.96 | 0.23 | **1.0** |
| Yes | 75 | 41.3% | 1.54 (1.15-2.05) | 1.20 (0.91-1.57) |
| **Hospital admission from one year to 22 months post childbirth** |
| No | 1,197 | 26.8% | **0.004** | **1.0** | 5.6 (3.4, 8.6);2.51 | 97.7 (96.5, 98.5); 0.97 | **0.03** | **1.0** |
| Yes | 39 | 48.7% | 1.82 (1.30-2.54) | 1.54 (1.12-2.12) |
| **Chronic illness (reported at any stage after childbirth)** |
| No | 817 | 20.0% | **<0.001** | **1.0** | 52.6 (47.2, 58.0); 1.96 | 73.2 (70.1, 76.0); 0.65 | **<0.001** | **1.0** |
| Yes | 421 | 42.9% | 2.15 (1.81-2.57) | 2.06 (1.71-2.48) |
| **Mode of childbirth** |
| Vaginal | 981 | 26.8% | 0.14 | 1.0 |  |  |  |  |
| Elective CS | 180 | 32.8% | 1.22 (0.97-1.54) |  |  |  |  |
| Emergency CS | 87 | 25.3% | 0.94 (0.65-1.37) |  |  |  |  |
| Other | 7 | 57.1% | 2.13 (1.11-4.08) |  |  |  |  |