# Hypertensive disorders during pregnancy

Hypertension in pregnancy is defined as having a systolic and/or diastolic blood pressure greater than or equal to 140 mmHg and 90 mmHg, respectively. Blood pressure measurements greater than or equal to 170 mmHg and 110 mmHg for systolic and diastolic, respectively, are indicative of severe hypertension.

Elevated blood pressure is the common feature of hypertensive pregnancy disorders (HPDs); however, these disorders can be further differentiated based on their unique characteristics. There is a general consensus among numerous national and international bodies on criteria for clinical classification of hypertensive disorders; the main differences (where there are differences) are with the requirement of proteinuria for the diagnosis of pre-eclampsia (Lowe et al. 2014).

According the Society of Obstetric Medicine of Australia and New Zealand (SOMANZ), hypertensive disorders during pregnancy can be grouped into one of the following classifications (Lowe et al. 2014):

- **Gestational hypertension**—Identified by the new onset of hypertension after 20 weeks of gestation, without any features of pre-eclampsia. Normalisation of blood pressure typically occurs in the post-partum period.
- **Chronic hypertension (essential, secondary, 'white coat')**—This classification relates to individuals with an existing hypertensive condition prior to pregnancy. Chronic hypertension may be further distinguished into essential and secondary hypertension, with the latter depending on whether the elevated blood pressure arises from a secondary cause such as chronic kidney disease, renal artery stenosis, systemic diseases, endocrine disorders or coarctation of the aorta.

  Women may also present with 'white coat' hypertension (WCH), which is indicated by hypertension that only arises within a clinical setting, with normal blood pressure in their usual home or work environment. White coat hypertensives typically have a long-term prognosis that is intermediate between hypertensive and normotensive individuals (Brown et al. 2005).
- **Pre-eclampsia/eclampsia**—Pre-eclampsia is a multi-system disorder characterised by the new onset of hypertension after 20 weeks gestation and presence of proteinuria, maternal organ dysfunction or uteroplacental dysfunction.
- **Pre-eclampsia superimposed on chronic hypertension**—This is characterised by the new onset of symptoms of pre-eclampsia in women with pre-existing chronic hypertension.

## Hypertensive disorders are a major cause of maternal morbidity and mortality

HPDs are a significant source of maternal morbidity, disability, and mortality. An estimated 10% of pregnancies worldwide have hypertensive disorders present (Duley 2009; Steegers et al. 2010). Furthermore, HPDs are a leading cause of maternal mortality, accounting for 12.9% and 14.0% of maternal deaths in developed and developing regions, respectively (Say et al. 2014).

Women diagnosed with chronic hypertension are at increased risk of developing adverse outcomes in pregnancy. There are numerous complications in pregnancy associated with chronic hypertension, including caesarean section, pre-term delivery, superimposed pre-eclampsia, neonatal unit admission, low birthweight and perinatal death (Chappell et al. 2014). Furthermore, research has shown that chronic hypertension plus the presence of one or more risk factors (including obesity, diabetes, smoking, and family/personal history of pre-eclampsia) is strongly associated with developing pre-eclampsia (Chappell et al. 2008).

Of the hypertensive disorders of pregnancy, pre-eclampsia is a distinct cause of maternal morbidity and mortality, and can lead to further problems in the kidney, liver, clotting system and neurological disorders (Duley 2009). Pre-eclampsia has also been associated with the development of deep vein thrombosis, type 2 diabetes and hypothyroidism (Williams 2011). Numerous systematic reviews and meta-analyses have indicated that there is an elevated risk of developing hypertension, cardiovascular disease and cerebrovascular disease in women previously diagnosed with pre-eclampsia (Bellamy et al. 2007; Brown et al. 2013; McDonald et al. 2008). Studies also indicate that women are at increased risk of death later in life from cardiovascular disease and stroke after a pre-eclamptic pregnancy (Irgens et al. 2001; Wilson et al. 2003). However, there is also evidence that suggests that lifestyle interventions may be useful in mitigating the risk of cardiovascular disease in women who have had a pre-eclamptic pregnancy (Berks et al. 2013).

Hypertensive disorders during pregnancy are also associated with adverse fetal outcomes compared with pregnancies in normotensive women. Adverse outcomes are more prevalent in instances of severe hypertension, superimposed pre-eclampsia, and where the onset of hypertension is at an early gestation. These conditions are related to an increase in the rate of fetal growth restriction (Bakker et al. 2011; Ferrer et al. 2000; McCowan et al. 1996; Vreeburg et al. 2004). One in four cases of pre-eclampsia is associated with fetal growth restriction, and 2% die in utero as a result of prematurity (Brown 2003; Thornton et al. 2013). Interestingly, children from pre-eclamptic pregnancies reportedly have increased cardiovascular risk factors (Davis et al. 2012).

## Risk factors and causes

The causes of HPD are largely unknown, with the exception of secondary chronic hypertension, which is commonly caused by chronic renal disease. The cause of pre-eclampsia is subject to debate. Most theories propose that the condition is initiated by an abnormal inflammatory/immune response; however, the exact cause remains unclear (Eiland et al. 2012).

Pre-existing hypertension is a strong risk factor for the development of pre-eclampsia, with numerous other susceptibility factors also implicated in development of the condition (Chappell et al. 2008; Duckitt & Harrington 2005; HAPO Study Cooperative Research Group 2008; Lowe et al. 2014; Milne et al. 2005; North et al. 2011). The most significant of these are:

- antiphospholipid syndrome
- previous history of pre-eclampsia
- pre-gestational diabetes and gestational diabetes
- nulliparity
- multiparity
- family history of pre-eclampsia
- obesity
- systolic blood pressure >130 mmHg before 20 weeks
- age ≥40 years
- overweight
- diastolic blood pressure >80 mmHg before 20 weeks.

The risk of developing pre-eclampsia appears to be increased if a combination of these risk factors is present. Studies suggest that ethnicity may also be a risk factor for developing HPDs (Chappell et al. 2008; Jacobs et al. 2003); however, the link is not well understood (Eiland et al. 2012).

## Prevalence/incidence, mortality and trends

HPDs affect 1 in 10 pregnancies, and are a leading cause of pregnancy complications and maternal death globally (Duley 2009; Say et al. 2014). The World Health Organization has reported that hypertensive disorders account for around 13% of maternal deaths in developed regions (14% in developing regions), with large variability across different regions (Say et al. 2014). In this study, Latin America and the Caribbean reported the highest rate (22.1% of direct maternal deaths), while the lowest rates were observed for Southern and Eastern Asia (10.3% and 10.4% of direct maternal deaths, respectively).

Of women with HPDs, around 20% have chronic hypertension, 40% have pre-eclampsia and 40% have gestational hypertension (Brown et al. 2005). Gestational hypertension is not typically associated with mortality in mothers. However, around 25% of women with gestational hypertension will progress to pre-eclampsia, with the likelihood increasing if the onset occurs before 32 weeks' gestation (Tranquilli et al. 2014).

HPDs are the second highest cause of direct maternal deaths worldwide (Say et al. 2014). Between 2008 and 2012, complications from HPD (pre-eclampsia/eclampsia) accounted for 18.4% (9 out of 49) of direct maternal deaths in Australia (AIHW et al. 2015). This figure is consistent with other data for developed (12.9%) and developing (14.0%) countries (Say et al. 2014; Thornton et al. 2013). In Australia, during 2008–2012, the maternal mortality ratio for deaths from hypertensive disorders (0.6 deaths per 100,000) was higher than the rate in 2006–2010 (0.4 deaths per 100,000), but lower than in previous reporting periods (0.8 in 2003–2005 and 0.7 in 2000–2002). These figures are, however, inconclusive due to the small number of maternal deaths in Australia in each reporting period, for example there were 9 maternal deaths from hypertensive disorders in 2008–2012 (AIHW et al. 2015).

Changes in maternal characteristics have contributed to an increased prevalence of HPDs in recent decades (Hutcheon et al. 2011a). In Australia, hypertension is becoming more prevalent in women of childbearing age, and in the Indigenous population (AHMAC 2012). Further, with the increasing prevalence of obesity, diabetes and advanced maternal age in western societies, it is expected that the incidence of HPD will continue to increase in the next decade (Lowe et al. 2014).

An estimated 1%–5% of all pregnancies are affected by chronic hypertension (Chappell et al. 2008). The majority of cases of chronic hypertension (95%) are attributed to essential hypertension (Magee at al. 2008). The primary concern with chronic hypertension in pregnancy is the progression to superimposed pre-eclampsia. Of the pregnancies affected by chronic hypertension, roughly 20% will progress to superimposed pre-eclampsia (Lowe et al. 2008). Further, women with pre-existing hypertension before pregnancy have a risk of perinatal death that is three times as high as that of singleton, normotensive pregnancies (Ahmad 2012; Hutcheon et al. 2011b).

A New South Wales study (Thornton et al. 2013) has reported an overall prevalence of pre-eclampsia between 2000 and 2008 of around 3%; between the beginning and end of this period the prevalence halved from 4.6% to 2.3% of singleton births. The study also showed that eclampsia is rare in Australia, being present in around 0.1% of all births, with this proportion remaining stable over the 2000–2008 period. Interestingly, this study also showed that the incidence of eclampsia and pre-eclampsia do not appear to be correlated.

Women who have previously been diagnosed with pre-eclampsia are at increased risk of developing the condition in a subsequent pregnancy. However, estimates of recurrence rates vary depending on the onset, with 5–8% recurrence in instances of late onset, and 25% in early onset cases (Brown 2003).

Recent developments in research into white coat hypertension (WCH) have warranted the differentiation of this condition from chronic hypertension (Franklin et al. 2013). White coat hypertension is common in early pregnancy, and presents as a risk factor for developing other HPDs. Of the women with WCH, around 40% progress to gestational hypertension, and 8% develop pre-eclampsia (Brown et al. 2005). Typically, these women have very good overall pregnancy outcomes (Brown et al. 2005). For women with WCH, the risks of developing severe hypertension and pregnancy complications are in between those of normotensive and hypertensive women (Lowe et al. 2014).

## Data collection and analysis issues

The main issues concerning data collection and analysis are related to variations within definitions and diagnostic criteria. Although there is a general consensus on classification and diagnostic criteria for HPDs, there are nevertheless several differences among different clinical practice guidelines.

A systematic review of clinical practice guidelines has shown that across these guidelines there are consistent definitions for hypertension, proteinuria, and chronic and gestational hypertension (Gillon et al. 2014). However this study also highlighted inconsistencies in definitions of pre-eclampsia, severe eclampsia, and superimposed pre-eclampsia. In 2014, the International Society for the Study of Hypertension in Pregnancy (ISSHP) recommended a revised set of classifications for hypertensive disorders of pregnancy for use in clinical practice guidelines (Tranquilli et al. 2014). The key areas of difference between some guidelines and ISSHP recommendations are the requirement of proteinuria for diagnosis of pre-eclampsia, and specifications regarding the extent, timing and targets of drug administration (Tranquilli et al. 2014).

In Australia, the principal clinical practice guidelines for HPDs are published by SOMANZ (Lowe et al. 2014). The diagnosis and recording of HPDs as set out in the SOMANZ guidelines has been reflected relatively recently in data collections such as the National Perinatal Data Collection (NPDC). Data on HPDs are not currently part of the Perinatal National Minimum Data Set (NMDS) but are supplied as voluntary items by all states and territories to the NPDC, which is held at the Australian Institute of Health and Welfare (AIHW). Definitions can vary greatly for voluntary data items (AIHW 2014). Until recently there was a lack of consistency with definitions and terminology among jurisdictions and a lack of consensus on the classifications (AIHW 2014). Recent work on standardising the definitions to enable consistent national data collection is described in the next section.

An alternative or additional data source to the perinatal data collection is hospital morbidity data. However a New South Wales study showed that HPDs are not always well recorded or differentiated in hospital morbidity data although at the aggregate level they may be more accurate than the perinatal data (Roberts et al. 2008).

## Data development undertaken through the National Maternity Data Development Project (NMDDP)

Stakeholders nominated HPDs as a high priority for national standardised collection, and accordingly they were included on the National Maternity Data Development Project (NMDDP) priority data item list for data development. See *Foundations for enhanced maternity data collection and reporting in Australia: National maternity data development project—Stage 1* (AIHW 2014) for more information on the NMDDP priority data item list.

Data development began in 2013 and included consultation with a clinical and data reference group (CDRG), the NMDDP Advisory Group and jurisdictional stakeholders. All agreed to use the SOMANZ classification of HPDs as the basis for definitions underpinning the national standards.

Two national health data standards for HPDs were developed:

*Female—hypertensive disorder during pregnancy indicator, yes/no/not stated/inadequately described code N (METeOR identifier 516807)*

*Female—type of hypertensive disorder during pregnancy, code N (METeOR identifier 504548).*

(More information about METeOR, the AIHW's metadata registry, is available on the AIHW website at <http://meteor.aihw.gov.au/content/index.phtml/itemId/181162>.)

These national data standards are included in the National Health Data Dictionary (AIHW 2012) and were included for the first time in the Perinatal Data Set Specification (DSS) 2014–15, for jurisdictions to collect from 1 July 2014 where feasible. While currently optional for collection, it is expected that the data elements will be included in a future Perinatal National Minimum Data Set (NMDS) making them mandatory items for collection once all jurisdictions are able to implement the necessary processes in their collections.

## Importance of national collection of these data items

HPDs are a significant source of maternal morbidity and mortality. These conditions are a leading cause of direct maternal deaths in Australia, and are associated with adverse maternal and neonatal outcomes. In Australia, inconsistencies in definitions, terminology and classifications among jurisdictions complicates the aggregation of data at a national level. Establishing a nationally consistent standard for the classification and reporting of HPDs is integral to improving maternal morbidity arising from these conditions.

The NMDDP aims to fix these inconsistencies through the inclusion of HPDs as part of the Perinatal NMDS. When all jurisdictions implement the new national standards, collection and reporting of national data will help with monitoring maternal and perinatal outcomes associated with HPDs. The data will also be useful in informing clinical practice and assist in planning health service delivery.

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