Perinatal Outcomes Among Indian-born Mothers in Australia

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Contents

List of Tables

List of Figures

Thesis Abstract

Background: Indian-born mothers giving birth in Australia are at risk of adverse perinatal outcomes. This risk is a concern for Australian maternity services and maternity care professionals seeking to achieve a high level of safety for mothers and their babies. Widely recognised maternal risk factors for adverse perinatal outcomes, such as maternal age >35 and <18years, drug and alcohol consumption, obesity, smoking, and single status, do not explain this risk to Indian-born mothers. This study will examine the incidence of adverse perinatal outcomes for Indian-born mothers compared to other mothers living and giving birth in Australia.

Method: This retrospective cohort study was designed to investigate all births in Australia in 2012. The National Perinatal Data set (NPD) consists of aggregated data including 312,215 births involving 215,009 Australian-born mothers, 10,297 Indian-born mothers, and 86,945 mothers born elsewhere overseas. A supplementary data source from Monash Health Birthing Outcomes System (BOS) 2014 was used to obtain unit level data involving 3,175 births, of which 1,211 mothers were Australian-born, 393 mothers were Indian-born, and 1,568 mothers were born elsewhere overseas. Data sets were analysed involving descriptive statistics using Statistical Package for Social Sciences (SPSS vs 23). Inferential statistics involving Chi-square tests were used in the analysis of aggregated data. Parametric and non-parametric tests were conducted on variables that were continuous or ordinal in nature, and cross-tabulations and contingency tables were used to analyse categorical adverse outcome variables.

Results: Indian-born mothers in Australia were over represented in the lower socioeconomic SEIFA IRSD category. Indian-born mothers planned to give birth in a public hospital and regularly attended scheduled antenatal appointments recipients of a high standard of maternity care, provided free of cost to all pregnant women. Indian-born mothers are at increased risk for induced labour, emergency caesarean section, very preterm birth (20 – 27 weeks), babies with low to very low birth weight, and Apgar score (0-2) at 5 minutes. Indian-born mothers have higher rates of medical conditions (gestational diabetes, hypothyroidism, iron deficiency anaemia and vitamin B12 deficiencies) that may, if untreated, contribute to obstetric complications. Overall, Indian-born mothers have a greater risk for adverse perinatal outcomes compared to other mothers giving birth in Australia. This increased risk occurs despite a range of protective factors (25–34 years age range, more likely to be married, be nonsmokers, and have a BMI <30) that would normally be expected to reduce the risk for adverse perinatal outcomes for mothers giving birth in a developed country.

Conclusion: In the absence of many of the recognized maternal risk factors, healthy young Indian-born mothers continue to face increased risk for adverse perinatal outcomes, despite access to high quality maternity care in Australia. Recommendations arising from this study include the need for an intervention study to identify maternal risk factors in mid to late pregnancy that contribute to the risk for very preterm birth and low birth weight.

Declaration

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Kanmani Barthasarathy

Thesis Outcome Summary

Oral Conference Presentations:

April 2017 PSANZ Congress, Canberra

Oral: “Perinatal outcomes for Indian-born mothers in Australia”

January 2016 International Nurses Conference, Tamil Nadu, India.

Oral: “Exploring adverse birth outcomes among Indian-born mothers living in Australia”. 12th International Nurses Conference.

October 2015 Saudi Student Conference, Melbourne

Oral: “Is maternal country of birth predictive of adverse birth outcomes in Australia”

July 2017 3MT School of Nursing & Midwifery Competition: Oral: “Perinatal outcomes for Indian-born mothers in Australia”.

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Glossary of Terms

Amniotic fluid	The liquid that is constantly being replenished by the fetus and fetal membranes during pregnancy. The fluid surrounds and protects the fetus during pregnancy from temperature extremes and trauma.
Antenatal/Antepartum	Before birth; occurring or existing before birth; refers to both the care of the woman and the growth of the fetus.
Antepartum haemorrhage (APH)	Bleeding from the birth canal after 20 weeks gestation and before birth.
APGAR score	An assessment performed at 1 minute and 5 minutes after birth to assess the baby's response to the birth and any resuscitation measures that may be required. If the baby requires active resuscitation, the APGAR score is performed every 5 minutes until improvement or resuscitation is ceased.
Bias	Inclusion of subjects or methods such that the results obtained are not truly representative of the population from which it is drawn.
Breech	Where the presentation of the fetus is buttocks or feet first. Includes complete, frank and footling.
Cohort	Is a component of a population identified so that one or more characteristic can be studied as it ages through time.
Confinement	A historical term to describe the final phase of pregnancy during which labour and childbirth occur. Synonymous with puerperium.
Crowning	The phase at the end of labour where the labia are stretched in a crown around the head just before birth.
Data	Facts or variables brought together for analysis.
Data cleaning	The process of reviewing the database for information needed for the new study, by retaining appropriate variables and removing unwanted data.
Database	An organised set of data collected in one place.

Data mining	The systematic process of searching large amounts of data for consistent and logical patterns or relationships between variables. Findings are then validated by applying discovered patterns to new subsets of data.
Dataset	A collection of data that belongs within a database.
Delivery	The medicalised term for the birth of a baby.
Early pregnancy loss	Loss of pregnancy at less than 20 weeks gestation.
Ectopic pregnancy	An abnormal pregnancy in which the blastocyte implants outside the uterine cavity. Implantation is usually in the fallopian tubes but can be in the abdomen or the ovary.
Emergency medical service	Is a system of services composed of emergency health practitioners, facilities and resources that work in unison to ensure that patients are provided optimum medical care.
Free birth	A birth in which the woman decides to give birth without support from personnel qualified in childbirth.
Gravida	Suffix - meaning the “pregnant woman with (specified) numbers of pregnancies”.
HELLP syndrome	Haemolysis-elevated liver enzymes and low platelets. A syndrome featuring a combination of symptoms involving haemolysis, elevated liver enzymes and low platelets. It is a form of pre-eclampsia often occurring later in pregnancy.
Labour	The time and the processes that occur during parturition from the beginning of cervical dilation to the birth of the baby.
Low-risk women *(in pregnancy)*	Women who have normal pregnancies that are uncomplicated by obstetric or medical conditions and birth occurs between 36 to 41 weeks gestation.
Maternity	The period during pregnancy and shortly after childbirth (Oxford Dictionary); the quality or state of being a mother.
Midwifery continuity of care	Consistent quality women centred care provided over a period of time by a single or small group of midwives.

Midwife	As defined by the International Confederation of Midwives, “is a person who has been successful in completing a midwifery educational program duly recognised in the country in which it is located and has acquired the requisite qualifications to be legally licensed to practise midwifery.
Miscarriage	The definition of "miscarriage" varies across different jurisdictions. In the state of Victoria "miscarriage" is defined as the birth of a fetus/baby before 20 weeks gestation.
Multigravida	A woman who has been pregnant more than once.
Multiparous	A woman who has given birth to at least one viable infant.
Null gravida	A woman who has never been pregnant.
Null parity/Nulliparous	A woman who has never borne a child; Never given birth.
Observational study	A study that is designed without interventions, as opposed to an experimental study. These studies provide estimates and examine associations between events in their natural context, not the relationship with an experimental intervention.
Obstetrics	Pertaining to pregnancy and childbirth. Usually associated with the medicalisation of childbirth.
Paramedic	A person who acts as an assistant to a doctor or in place of a doctor. As they have gained increased clinical expertise, contemporary "ambulance officers" are often referred to as "paramedics".
Plurality	Plurality at birth is determined by the total number of live births and stillbirths that result from the pregnancy.
Postnatal/Postpartum	Usually the first six weeks after birth.
Precipitous labour	Labour that is completed quickly, usually within three hours.
Pre-eclampsia	An abnormal condition of pregnancy characterised by the onset of hypertension and proteinuria in the latter half of the pregnancy.
Pregnancy	The period comprising growth and development from fertilisation until birth. See ‘gestation’.

Perinatal	The period from 20 weeks gestation until the 28th day after birth.
Prevalence	Is not defined by a period of time so is not a rate. It may be defined by the number of cases of interest such as a particular disease that exist in a defined population at a specified point in time or period of time but each case is counted independently.
Prim gravida	A woman who is pregnant for the first time.
Prim Para	A woman who has given birth to one viable infant.
Puerperium	Less frequently used term for the postpartum period. It is the time after childbirth lasting about six weeks during which the anatomical and physiological changes of pregnancy revert to their pre-pregnancy state.
Randomised control trial	Subjects are assigned by statistical randomised methods to two or more groups to minimise bias. All variables, other than the proposed intervention, are assumed to be evenly distributed between groups.
Relative risk	The probability of developing a condition if exposed to a particular variable compared to the probability if not exposed.
Stillbirth	Birth of a baby after 20 weeks showing no signs of life at birth. The definition of "birth" varies across different jurisdictions. In the state of Victoria, the definition of "birth" is after 20 weeks gestation.
Variables	A value or quality that can vary between subjects and /or over time.

List of Abbreviations

ABS	Australian Bureau of Statistics.
AIHW	Australian Institute of Health and Welfare.
AMOSS	Australasian Maternity Outcomes Surveillance System.
APH	Antepartum haemorrhage.
ASGC-RA	Australian Standard Geographical Classification Remoteness Area.
BMI	Body Mass Index.
BOS	Birthing Oucomes System.
CCOPMM	Consultative Council on Obstetrics and Paediatric Mortality and Morbidity.
CERTs	Community Emergency Response Teams.
CPGs	Clinical Practice Guidelines.
EBM	Evidence Based Medicine.
EBP	Evidence Based Practice.
ED	Emergency Department.
EDC/ EDD	Expected Date of Confinement/ Expected due date.
EDOS	Emergency Domiciliary Obstetric Service.
FGR	Fetal Growth Restriction.
G	Gravida.
GDM	Gestational Diabetes Mellitus
IPE	Inter-professional Education.
IPL	Inter-professional Learning.
IRSD	Index of Relative Socioeconomic Disadvantage.
IUGR	Intrauterine Growth Restriction.
LBW	Low Birth Weight.
LGA	Large for Gestational Age.

MUHREC	Monash University Human Research Ethics Committee.
NPD	National Perinatal Data.
P	Para.
PERS	Perinatal Emergency Referral Service.
PIPER	Paediatric Infant Perinatal Emergency Retrieval.
PND	Postnatal Depression.
PLRM/PROM	Prelabor Rupture of Membrane.
PTB	Preterm Birth.
PPH	Postpartum Haemorrhage.
PPLRM/PPROM	Preterm Prelabor Rupture of Membranes.
SACC	Standard Australian Classification of Countries.
SAS	Statistical Analysis system.
SDH	Social Determinants of Health.
SEIFA IRSD	Socio-Economic Indexes For Areas Index of Relative Socio-Economic Disadvantage .
SES	Socioeconomic Status.
SGA	Small for Gestational Age.
SPSS	Statistical Package for Social Sciences.
US	United States of America.
WHO	World Health Organisation.

Ethics Approval

Monash University, Melbourne, Australia

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CHAPTER ONE: INTRODUCTION

1.1 Background

Little is known about the impact that maternal country of birth and ethnicity has on perinatal outcomes. Maternal country of birth has been identified as a potential risk factor for adverse perinatal outcomes including low birth weight and premature birth (H. G. Dahlen, Schmied, Dennis, & Thornton, 2013; Davies-Tuck et al., 2015; Essén, Hanson, Ostergren, Lindquist, & Gudmundsson, 2000; Gagnon, Zimbeck, Zeitlin, & Collaboration, 2009; Gordon, Raynes-Greenow, McGeechan, Morris, & Jeffery, 2013; Milewski & Peters, 2014; M. L. Urquia et al., 2010). Whilst studies report an association between the cultural impact of migration and maternal stress during pregnancy, an association also contributing to adverse perinatal outcomes (Alder, Fink, Bitzer, Hösli, & Holzgreve, 2007; H. G. Dahlen et al., 2015; Dole et al., 2003; Rondó et al., 2003; Torche, 2011), this study will focus on adverse perinatal outcomes in a migrant setting from a medicalised point of view.

Australia is home to a large immigrant population of women of childbearing age who need access to maternity care, the health culture of which is different to their country of origin (Carolan & Cassar, 2010; Shafiei, Small, & McLachlan, 2012; M. M. Smith, 2006). In 2016, Australia had a population of 24.4 million, of which 28.5% (6.9 million people) were born overseas (ABS, 2017a). The Indian-born migrant population continues to be the fourth largest group in Australia at 1.9% (ABS, 2017a). Indian-born mothers are reported to have an increased incidence of adverse perinatal outcomes

compared to that of Australian-born mothers (H. G. Dahlen et al., 2013; M. L. Davies-Tuck, Davey, & Wallace, 2017).

Australia provides universal access to internationally recognised, quality maternity services, as measured by national maternal and perinatal mortality rates which rank Australia among the best in the world (McIntyre, 2012). However, it appears that access to quality maternity services does not protect Indian-born mothers from an increased incidence of adverse perinatal outcomes when giving birth in Australia (H. G. Dahlen et al., 2013). The specific focus of this current study relates to Indian-born mothers who gave birth in Australia in 2012. To simplify the nomenclature used in this study, mothers born in India are labelled ‘Indian-born mothers’ and other mothers not born in Australia are labelled ‘Other overseas-born mothers’. This nomenclature is consistent with that used for standard country classification where India is included under the classification of Southern Asia (United Nations Statistics Division, 2016).

Indian-born mothers who gave birth in 2012 in Australia represent 3.3% of a total of 31.2% of all mothers born in countries other than Australia (Hilder, Zhichao, Parker, Jahan, & Chambers, 2014). There are limited perinatal studies published investigating mothers’ country of birth as a risk for adverse perinatal outcomes (H. G. Dahlen et al., 2013; M. L. Davies-Tuck et al., 2017; Drysdale, Ranasinha, Kendall, Knight, & Wallace, 2012; WHO, 2014). A gap has been identified by the researcher in the evidence available when examining the increased risk that Indian-born mothers face for adverse perinatal outcomes.

Studies related to perinatal outcomes in Australia that include immigrant women have an emphasis on specific sub-immigrant populations, or are implemented using smaller sample sizes (Burton & Lancaster, 1999; Drysdale et al., 2012; Rundle, Barclay, Nivison-Smith, & Lloyd, 1996; Westerway, Keogh, Heard, & Morris, 2003). Based on ethnicity, international studies report significant disparities in perinatal outcomes (Bryant, Worjoloh, Caughey, & Washington, 2010; Mantell, Craig, Stewart, Ekeroma, & Mitchell, 2004; C. R. Stein et al., 2009) when associated with immigrant status (Cacciani et al., 2011; Gagnon et al., 2009; Qin & Gould, 2010; M. Urquia, Frank, Moineddin, & Glazier, 2010).

In developing countries comprising large rural regions such as India, maternal health care remains a challenge (Patton et al., 2010). This issue is acknowledged by the United Nations through Millennium Development Goals (MDG). MDG aimed to reduce maternal and neonatal mortality rates by 75% during the period 1990-2015 (P. K. Singh, Rai, Alagarajan, & Singh, 2012; United Nations Children's Fund, 2015). The MDG target for 2015 was to achieve less than 109 maternal deaths per 100,000 of live births, and an infant mortality rate of less than 27 infant deaths per 1,000 of live births (United Nations Children's Fund, 2015). Unfortunately, India has been unable to achieve the MDG targets, although they have succeeded in some reduction in maternal and perinatal death rates.

By 2015, India achieved a decline in the infant mortality rate to 38 per 1,000 live births (United Nations Children's Fund, 2015, pp. 90-91) and a decline in the maternal mortality rate to 167 per 100,000 live births (2011-2013) (Social Statistics Division,

2015, p. 84). However, underreporting hampers the accurate estimation of the numbers of infant and maternal deaths and stillbirths in India(Negandhi et al., 2016). For example, in Haryana, one of the second wealthiest states in India, the recorded rates of infant mortality is 42 infant deaths per 1,000 live births and 9 stillbirths per 1,000 births, witha maternal mortality ratio of 146 maternal deaths per 100,000 live births that are similar or worse than the national mean values (Negandhi et al., 2016). It is, however, unlikely that the official national and state records of infant and maternal mortality and stillbirth are accurate. Although such records may be supplemented by data collected by routine health services or in sample surveys, they are usually largely based on vital statistics (Lawn, Gravett, Nunes, Rubens, & Stanton, 2010). In most low- and middle-income countries, the partial registration of births and deaths results in inaccurate vital statistics (Negandhi et al., 2016). It has been expected that Indian-born mothers migrating to Australia would benefit by accessing Australian maternity services, exhibiting a demonstrable drop in incidence for adverse perinatal outcomes. That this has not occurred to the degree expected is an unexplained anomaly.

The Australian health system is similar to that of the UK in providing high quality publically-funded maternity services to all pregnant women. It is of concern that, despite access to quality maternity care, some groups of immigrant mothers continue to have increased risks of adverse perinatal outcomes. This situation persists even when these young and healthy immigrant mothers are identified as low risk for pregnancy related complications. In seeking answers to explain this anomaly, several authors have suggested that factors linked to maternal ethnicity may be responsible for this increased risk for adverse perinatal outcomes (H. G. Dahlen et al., 2013; M. L. Davies-Tuck et al., 2017; Drysdale et al., 2012). There may also be other, as yet

unidentified, causative factors involved that are unrelated to either immigration or maternal ethnicity that explain why Indian-born mothers have an increased incidence of adverse perinatal outcomes, despite receiving first world maternity care. The current study has arisen as a result of continuing disparities in perinatal outcomes relating to India-born mothers giving birth in Australia.

This introduction provides a description of Australian maternity services, including legislated reporting for all births. This description is contrasted with the Indian maternal health care and reporting system. The issue of maternal ethnicity as a risk for adverse birth outcomes is explored. The Australian maternity service's 'one size that fits all' model of care provision will be questioned in relation to the care provided to low risk, healthy, young, Indian-born mothers.

1.2 Indian Immigrants in Australia

Australian immigration policy is based on the skills and knowledge that immigrants contribute to the Australian workforce (Vrachnas, Bagaric, Dimopoulos, & Pathinayake, 2011, p. 25). Current Australian immigration policy states that people from any country are permitted to apply to migrate to Australia, regardless of language, culture, religion, and ethnicity, provided they legally meet the established criteria (DIAC, 2013). Migration to Australia from India commenced during the 19th century, and is one of the top-three source countries of migrants to Australia today (DIAC, 2014). The main motivation for Indians to immigrate to Australia is for financial gain and improved living standards (Khadria, 2006). Indian immigrants are predominantly employed in either a skilled managerial or professional occupation (48.4 %) (DIAC,

2014). June 2016 population statistics report that Indians represent the fourth largest migrant group living in Australia, equivalent to 1.9 percent of Australia's total population (ABS, 2017a). These statistics suggest that immigrant Indians reside in middle class communities, as low to middle income earners, with access to social support enabling assimilation into life in Australia.

The experience of Indian-born mothers who have migrated to Australia is varied due to significant differences in cultural practices and beliefs, particularly those involving pregnancy and childbirth. The Indian childbearing traditions reflect the beliefs and expectations held by people and their communities (Y. O. Wells & Dietsch, 2014). The childbearing woman is expected to follow certain behavioural and dietary protocols (Y. O. Wells & Dietsch, 2014). The woman expects extensive physical and emotional support from her family and others around her (Y. O. Wells & Dietsch, 2014). Indian women who give birth in Australia also experience a transition to motherhood in a new culture. While adjusting to their new role as mothers, these women are also negotiating between old and new cultural identities (Y. O. Wells & Dietsch, 2014).

Australian maternity services are different to those provided in India, contributing to cultural conflicts when confonted by contrary instructions or advice from maternity care professionals (Schmied et al., 2012). Immigrant Indian mothers associated with the skilled migrant scheme are predominantly well-educated with varying English language capability on arrival in Australia (Mosiqi Acharya, 2017; Reji J, 2012). It has been reported that limited health literacy contributes to the difficulty navigating the Australian Health Care System, including the unfamiliar Australian model of maternity

care (Davidson et al., 2004; Ell & Castaneda, 2013; Scheppers, Van Dongen, Dekker, Geertzen, & Dekker, 2006). Public maternity services in Australia offer written information and interpreter services in numerous languages for mothers once they have accessed the service. However, a delay in accessing antenatal care is a common experience with new immigrant mothers, who often do not know where to go as the first step towards accessing pregnancy care.

Hannah Grace Dahlen, in a New South Wales study, stated that Indian-born mothers had a much higher rate of private health insurance (H. G. Dahlen et al., 2015). Her previous study demonstrated the link between low-risk primiparous women giving birth in private hospitals having higher rates of surgical birth and obstetric intervention rates (H. G. Dahlen et al., 2015; H. G. Dahlen et al., 2012; H. G. Dahlen et al., 2014). A Sydney hospital study looked at the variations in psychosocial risk factors among women born overseas. It found that women from several countries (including Pakistan and India) reported no mental health disorders despite reporting a family history of mental health disorders including anxiety and depression (H. G. Dahlen et al., 2015). There are significant differences in obstetric and psychosocial risk profiles and maternal and neonatal outcomes between Australian-born and non-Australian born women (H. G. Dahlen et al., 2015).

A Study among the multicultural population in Western Sydney states that Indian-born mothers, as the largest migrant group, were the least likely to say they experienced intimate partner violence (IPV), a global health issue affecting women and known to escalate during pregnancy and impact negatively on obstetric and perinatal outcomes

(H. G. Dahlen, Munoz, Schmied, & Thornton, 2018). This under-reporting is due to psychological and cultural concerns about sharing with strangers what is considered to be family business, something that is accepted in their country of origin (Poljski & Murdolo, 2011). The women are likely to have fewer social support systems in place that could buffer or protect them and their children from the effects of intimate partner violence (Coker et al., 2002).

Chiswick et al. (2008) examined the determinants of post-arrival immigrant health in a major immigrant-receiving country, Australia. A longitudinal survey of recently arrived immigrants who received their visas before entry into Australia revealed that immigrant women having babies in Australia reported better health outcomes in those who were younger, more educated, more proficient in English, and residing outside an ethnic enclave (Chiswick, Lee, & Miller, 2008). A study on the relationship between the strategies used by South Asian American women to cope with discrimination, isolation and stressors (Kaduvettoor-Davidson & Inman, 2013; C. T. Liang, Nathwani, Ahmad, & Prince, 2010) showed that the sense of stress faced by the family may be accompanied by the internalization of an alien status reinforced by various forms of discrimination (e.g. racism, sexism, gendered racism) (N. R. Patel, 2007).

Further, a study of race-based based discrimination among first generation Asian Indians in the US stated that pre and postimmigration experiences seem salient to race-based experiences of Asian Indians in the United States. Attempts at making meaning of Asian Indian race-based experiences were strongly influenced by the caste system, preimmigration colonial influence, and the model minority myth (Inman,

Tummala-Narra, Kaduvettoor-Davidson, Alvarez, & Yeh, 2015). Studies reveal that generational status may be an important mediating factor in differing health outcomes of first and subsequent generations (Viruell-Fuentes, 2007). Recent studies on migration and the healthy migrant effect in Australia suggest that immigrants to Australia come from different environments and, therefore, their physical and mental health is affected by many factors including the pre-migration environment in the country of origin, the timing or wave of migration, the migration stream category, and the degree of integration in Australia (Renzaho, 2016).

1.3 South Asian Indian Mothers

Indian immigrants often move to other countries with pre-immigration dreams of future success achieved through their children (Bhattacharya & Schoppelrey, 2004; Inman, Howard, Beaumont, & Walker, 2007). Indian-born migrant beliefs, practices, and traditions associated with pregnancy, birth, and parenting (e.g. food preferences, family, religion, and not showering after birth) and their contrast with Australian maternity and child health services may be a source of distress for an Indian-born mother recently arrived in Australia (Farver, Narang, & Bhadha, 2002). Overseas-born mothers may be unintentionally marginalized by a health care system that is not suitably aware of individual psychological and cultural practices, such as variations in cultural understandings of health, illness, well-being, and access to health care (Small et al., 2014; Tsianakas & Liamputtong, 2002).

Studies report that it is essential that Australian midwives reflect on their own culture, often techno-centric in practice, in an informed way if they are to provide culturally safe

care to Indian-born mothers (Y. O. Wells & Dietsch, 2014). Indian-born mothers are historically renowned for having small healthy babies when compared to mothers from Western countries (Leon & Moser, 2012; Margetts, Yusof, Al Dallal, & Jackson, 2002; Qin & Gould, 2010; J. C. Wells, Sharp, Steer, & Leon, 2013), a situation which is often overlooked in routine neonatal care. Anxiety is enhanced for these mothers in Australian maternity services where babies with low birth weight are associated with adverse outcomes involving routine admission to neonatal nursery and rigid feeding regimes (S. J. Brown, Yelland, Sutherland, Baghurst, & Robinson, 2011). Generally low birth weight babies are associated with intrauterine growth restriction in pregnancy, often linked with underweight mothers in developing countries like India (Black et al., 2008). It is important to note that Indian-born mothers continue to give birth to low birth weight babies following immigration to Western countries (Essén et al., 2000; Gagnon et al., 2009; Milewski & Peters, 2014; M. L. Urquia et al., 2010). Findings noting incongruity between a mother's ethnicity and birth outcomes have been reported since the 1990's in medical charts and administrative databases (Hahn, 1999; Ma & Bauman, 1996; Maizlish & Herrera, 2006). From these early reports, a specific focus on Asian ethnicity and birth outcomes has evolved (Hayes, Lukacs, & Schoendorf, 2008).

The phenomena associated with premature placental aging impacting birth outcomes in Asian mothers has been proposed by several authors to explain the association between ethnicity and birth outcomes (H. G. Dahlen et al., 2013; M. L. Davies-Tuck et al., 2017; Kinare et al., 2000; D. A. Miller, 2005). These studies report that Indian-born mothers have smaller placental surface area, placental weight, and volume compared to other Asians (Sivarao et al., 2002; R. Smith, Maiti, & Aitken, 2013). A recent review

has identified a concerning lack of emphasis on Indian-born mothers as a whole (M. L. Davies-Tuck et al., 2017). Findings from this current study are expected to inform maternity health professionals in their care of Indian-born mothers in Australia.

1.4 Australian Maternity Health Care System

The maternity health care system in Australia is provided through mixed public and private maternity care services (AIHW, 2016). In Australia, mothers receive free treatment in a public hospital, funded by the government through Medicare (Department of Health, 2017a). Medicare and the Pharmaceutical Scheme are the two major national government subsidy schemes that covers the medical expenses of all Australian citizens and permanent residents (ABS, 2012). Private health insurance is available for those who can afford it, and cover costs of other ancillary health services (AIHW, 2016). Primary maternity services in Australia are provided for women at low risk by general practitioners and midwives (Batterham et al., 2002; Hawley, Janamian, Jackson, & Wilkinson, 2014).

The 'National Maternity Services Plan' (NMSP) recognises the importance of universal access to maternity services across Australia (Department of Health, 2017b). It is predicated on low risk primary maternity services for a majority of mothers during the antenatal period, birth, and for a postnatal period up to six weeks (Department of Health, 2017b). Mothers are normally booked into hospital for birth at the first antentatal visit, and discharged home within 24 hours postnatally (S. Brown, Small, Argus, Davis, & Krastev, 2002). Publically-funded secondary and tertiary level maternity units situated within large metropolitan and regional hospitals provide

specialist medical care for mothers considered at increased risk for adverse pregnancy or birth outcomes (AIHW, 2016). Women who have private health insurance, irrespective of risk for adverse birth outcomes, have the option of specialist obstetric care for the duration of the pregnancy, including a 3-5 day inpatient postnatal stay in a private hospital (AIHW, 2016). An estimated 92.7% of Australian-born mothers receive maternity care through public hospital and shared maternity care arrangements (Commomwealth of Australia, 2009).

The model of antenatal care provided for each mother varies according to their identified risk for adverse pregnancy or birth outcomes. General practitioners (GPs) and midwives are publically-funded providers for primary maternity care for mothers considered as low risk for adverse perinatal outcomes (Commomwealth of Australia, 2009). Antenatal care guidelines for all pregnancies must be followed by all maternity care providers in Australia (Department of Health, 2018). Despite the universal application of antenatal guidelines, health disparities exist between Australian-born mothers, especially those from low socioeconomic households and rural and remote areas (Department of Health, 2017b). Inequality in access to Australia maternity services exists in rural and remote areas linked to the non-viability of very small maternity units in small country hospitals. Pregnant women living in rural areas are required to travel long distances for antenatal care in addition to paying travel and accommodation expenses (Commomwealth of Australia, 2009). Routine antenatal care provided by quality maternity care providers is associated with health benefits for both mother and baby (Hilder, Zhichao, et al., 2014).

Australia benefits from the best global standards health indicators, reflecting the achievement of the lowest infant mortality rate ratio in the world at 3.1 per 1,000 live births (ABS, 2017c). However, there exist disparities within Australian populations. In many health indicators, Indigenous Australians have disparities compared to non-Indigenous Australians (Australian Institute of Health and Welfare, 2017). Surprisingly, despite the stellar performance of the Australian maternity care sytem, Indian-born mothers are not benefiting as expected. Factors associated with this increased risk for Indian-born mothers must be identified to inform future maternity care advances in Australia.

1.4.1 National Reporting System for All Births

Australia's mothers and babies series publishes an annual perinatal statistics report, encompassing birth outcomes for all births that occurred in that year across the country (Hilder, Zhichao, et al., 2014). The Australian government has legislated that all eligible births must be recorded using the standard national perinatal survey. An eligible birth is defined as 400 grams birthweight or at least 20 completed weeks' gestation (Australian Institute of Health and Welfare, 2017).

The National Perinatal Data Collection Unit (NPDCU) is situated within the Institute of Health and Welfare (AIHW) (Australian Institute of Health and Welfare, 2017). Perinatal data is collected for each birth in each state and territory by midwives or other qualified maternity care professionals present at the birth (Australian Institute of Health and Welfare, 2017; Gibson-Helm et al., 2014). It is the responsibility of each state and territory to supply annual birth data to the National Perinatal Statistics Unit.

For the current study, the 2012 National Perinatal Data set was used in addition to a 2014 data set from a tertiary maternity hospital network in Victoria. The 2014 tertiary maternity service data set is a subset of the Victorian Perinatal Data Collection for 2014 which contributed data to the 2014 Mothers and Babies national report (Victorian Government, 2018). The relationship between the two data sets has been represented in Figure 1.

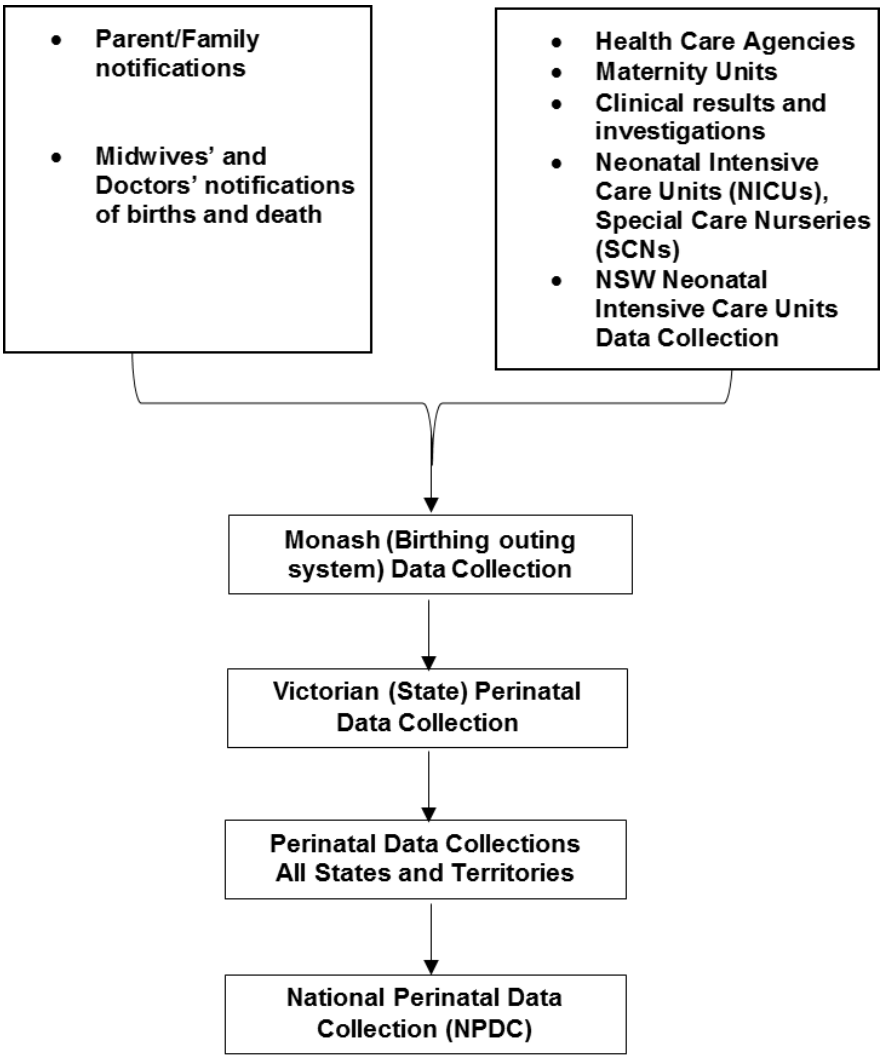

***Figure 1*. Relationship between Data Collection**

Current advances in health information technology in collecting and storing information generated by electronic health records can provide new opportunities for health research (Coorevits et al., 2013). Although originally the NPD and Monash Health Birthing Outcomes System (BOS) data sets were collected for other purposes, these data sets can be used to address a wide range of questions (Knottnerus & Tugwell, 2011; Mann, 2003). One of the major benefits associated with using pre-existing large data sets for population based research is cost effectiveness (Coorevits et al., 2013; Knottnerus & Tugwell, 2011). This current study involves the comparison of adverse perinatal outcomes for all mothers giving birth in Australia in 2012 and a subset of mothers giving birth in Victoria in 2014. The large data sets are useful in describing what exists in practice and for sourcing further insights in the discipline (Axford et al., 2004).

1.5 Indian Maternity Care System

The maternity health care system in India is comprised of a mixed public and private provider service. Indian public health standards ensure the provision of uniform quality services at all levels of health care delivery including maternity services in India (Ministry of Health & Family Welfare, December 2011). Equitable access to maternity care in India is hampered by the country's size and large rural and regional areas, which have historically been underserviced (Ministry of health & family welfare, 2013). As a result, a 2007-2008 report indicated that 25% of mothers had not attended an antenatal clinic during their pregnancy (International Institute for Population Sciences, 2010, p. 53), and that most of the deliveries are not attended by a skilled birth attendant and lack access to emergency obstetric care (Koblinsky et al., 2006; D. Mavalankar,

Singh, Bhat, Desai, & Patel, 2008; D. V. Mavalankar & Rosenfield, 2005; Rosenfield, Maine, & Freedman, 2006).

Of those mothers who did attend antenatal clinics, 24% attended two or less appointments (International Institute for Population Sciences, 2010, p. 60). In India poor antenatal attendance was reported to be associated with the mothers' level of education, caste, and wealth index (International Institute for Population Sciences, 2010, p. 60). The Indian standard for antenatal care involves a minimum of four visits with a qualified maternity care professional. The initial antenatal appointment takes place in the first trimester and involves the following: physical and abdominal examinations; Haemoglobin (Hb) estimation; urine analysis; commencement of tetanus toxoid immunisation; and the prescription of iron supplements (International Institute for Population Sciences, 2010, p. 56 and 61). Non-institutional births were reported in rural areas (20%) and urban areas (11%) (Ministry of Statistics and Programme Implementation, 2016). The duration of stay in rural areas, for institutional childbirth in a public hospital is 3 days, with 5 days stay in private hospital. In urban areas, these were reported as 4 days and 5 days, respectively (Ministry of Statistics and Programme Implementation, 2016).

Since 2005, the Indian maternal health care system has implemented change with the launch of the National Rural Health Mission (NRHM). The NRHM is responsible for the delivery of accessible, equitable, affordable, and quality health care to the vast rural populations and vulnerable population groups (Ministry of health & family welfare, 2013). This change requires a qualified maternity care professional to be present at

every birth in both the community and at an institutional level (Ministry of health & family welfare, 2013). Inspite of the emphasis on childbirth reforms, the progress in achieving institutional births and skilled attendance has been slower than desired. In the rural sector of the State of Gujarat, 45% of deliveries were attended by a Traditional Birth Attendants (TBAs) (B. Sharma, Giri, Christensson, Ramani, & Johansson, 2013), with the State providing limited choices, and inequitably distributed health centres, and health providers (M. Rao, Rao, Kumar, Chatterjee, & Sundararaman, 2011). The result is a weak health system where maternal and neonatal mortality rates are high (B. Sharma et al., 2013).

However, whilst women have shifted to hospitals for birth, they are not fully satisfied with the quality of services provided, especially from a psychosocial perspective (B. Sharma et al., 2013). Maternal health policies and strategies have been an important contributor towards the transition from home to hospital in regions with a good general economic development (B. Sharma et al., 2013). However, in difficult regions with poor economic progress and where it is not possible to ensure hospital births, the same strategies may not work. Instead of taking away the limited existing choices available to the women, in terms of homebirths by TBAs, there is a need to understand, respect, and integrate psychological and cultural interpretations of childbirth with the maternal health policies (B. Sharma et al., 2013).

In addition, the Indian government has introduced a scheme for poor and marginalised rural women, reducing out-of-pocket expenditures (OOPE) for those who attend antenatal and post-natal care and give birth in institutions (Ministry of Health & Family

Welfare, December 2011; Mohanty, 2012; A. Singh et al., 2012; P. K. Singh et al., 2012). A refinement to this scheme, including free delivery of caesarean section for all pregnant mothers delivering in public health institutions, was introduced in 2013 (Ministry of Health & Family Welfare, 2011, November 2013). However, studies in India found that the caesarean section rate in the private sector was 28% compared with 5% in the public sector (Neuman et al., 2014). Also, there is an association between education and type of facility, with highly educated women particularly likely to receive caesarean deliveries in private facilities in urban India (Neuman et al., 2014), and the increased caesarean section rates may be driven in part by the private sector (Neuman et al., 2014).

A further initiative implemented in an attempt to reduce maternal mortality in India involves the designation of anaemia during pregnancy and childbirth as a notifiable condition. The presence of anaemia in pregnancy mandates ongoing monitoring and treatment by an auxiliary nurse midwife supervised by the medical officer in charge of the local primary health centre (PHC) (Ministry of Health & Family Welfare, 2011, December 2011). Despite the introduction of these schemes more than a decade ago, recent studies have reported that the high cost of quality maternity care services is preventing safe motherhood in India (Kesterton, Cleland, Sloggett, & Ronsmans, 2010; Lim et al., 2010; Modugu, Kumar, Kumar, & Millett, 2012; Roy & Howard, 2007; Skordis-Worrall et al., 2011). The choices for safe delivery are influenced by cost accessibility and perceived quality of care (Das et al., 2016). Overall, Indian women expect to receive a better quality of maternity care on arrival in Australia as the Australian maternity service is one of the safest maternity care systems in the world (AHMC, 2010).

1.5.1 India's National Reporting System for All Births

Civil registration of all births (including livebirth, stillbirth, birth history); type and place of birth; and mother's health details is mandated. These are recorded in the Annual Health Survey-Woman Schedule (Government of India, 2012-2015). Recording of the birth registrations is the responsibility of the 601 district administrators from the 34 states and 7 union territories of India (Government of India, 2012-2015). To date, there is no nationally collated data set reporting maternal and perinatal outcomes.

1.6 Significance of the Study

Australia boasts one of the safest maternity care systems in the world, with very low rates of maternal and perinatal mortality. It is, therefore, unexpected that immigrant Indian-born mothers continue to experience increased risk for adverse perinatal outcomes despite access to world class maternity care. No studies have examined perinatal outcomes for Indian-born mothers in Australia. The findings of this current study will measure the incidence of this increased risk compared to other mothers, and identify the risk factors associated. This current study will contribute to existing knowledge on adverse perinatal outcomes, informing maternity care service providers of the specific risks faced by Indian-born mothers.

1.7 Study Purpose

While numerous studies have reported on maternal risk for adverse perinatal outcomes, very few have considered maternal ethnicity and country of birth as a risk in itself. The purpose of this study is to identify the incidence of adverse perinatal outcomes for Indian-born mothers compared to other mothers living and giving birth in

Australia. The study will investigate whether internationally agreed pregnancy risk factors for adverse perinatal outcomes used in mainstream maternity care can be usefully applied to predict risk for Indian-born mothers. The research questions guiding the study are:

1. What identifiable socio-demographic risk factors, as they relate to obstetrics, are present prior to or during labour/delivery that can predict adverse perinatal outcomes among Indian-born mothers in Australia?
2. How do these outcomes compare to other overseas-born mothers in Australia?

1.8 Research Aim and Objective

Aim: To examine the incidence of adverse perinatal outcomes for Indian-born mothers compared to other mothers living and giving birth in Australia.

Objective:

1. To identify the risk for adverse perinatal outcomes of Indian-born mothers compared to other mothers.

This study is an opportunity to inform appropriate pregnancy care for Indian-born mothers, and to ensure that maternity care providers understand the associated risks and plan care accordingly.

1.9 Research Hypotheses

- There is an association between maternal country of birth and increased risk of adverse perinatal outcomes.
- There is an association between certain aspects of personal, socioeconomic, behavioural, and biological factors affecting the mother that contribute to adverse perinatal outcomes.
- There is an association between previous adverse pregnancy outcomes and subsequent perinatal outcomes.

1.10 Operational Definition

Incidence:

Incidence is a measure of the probability of occurrence of a given medical condition in a population within a specified period of time. Although sometimes loosely expressed simply as the number of new cases during a specific time period, it is better expressed as a proportion or a rate with a denominator.

Adverse Perinatal Outcomes:

Adverse perinatal outcomes include the following: low birth weight infants <2500 grams, preterm births, live born babies having a low APGAR score (between 0 and 6) at 5 minutes, babies admitted to a Special Care Unit or Neonatal Intensive Care Unit, congenital anomalies, and stillbirth (Essén et al., 2000; Hilder, Zhichao, et al., 2014; M. L. Urquia et al., 2010).

Indian-born Mothers:

Women born in India only (not extending to include the Indian subcontinent) who experienced adverse perinatal outcomes, without any complications, during pregnancy and delivery in an Australian setting.

Other overseas-born Mothers:

Women not born in Australia or India who experienced adverse perinatal outcomes, without any complications during pregnancy and delivery, in an Australian setting.

Australian-born Mothers:

Women born in Australia who experienced adverse perinatal outcomes, without any complications during pregnancy and delivery, in an Australian setting.

1.11 Organization of the Thesis

The current thesis comprises six chapters - an introduction, a literature review, the research methodology, the results, an analysis, followed by a conclusion including recommendations.

Chapter One: Introduction

Chapter One presents the unique maternity care contexts involved in the current study, describing the differences between services provided in Australia and India. It

describes the research questions, aim, objective, overview of the problem, and the significance of the study, and includes the definition of key terms.

Chapter Two: Literature Review

Chapter Two presents both a narrative review and a scoping review of published findings on the topic. The narrative review describes risk factors associated with adverse perinatal outcomes, and the scoping review reports on adverse perinatal outcomes. The narrative review presents new evidence related to the influence that maternal country of birth and ethnicity may have on the risk to Indian-born mothers for adverse perinatal outcomes.

Chapter Three: Methodology

Chapter Three describes the quantitative, descriptive, correlational research methodology employed for this study, comparing perinatal outcomes for Indian-born mothers to other mothers giving birth in Australia. Justifications for the quantitative approach, choice of data sets, data analysis plan, and ethical considerations are provided.

Chapter Four: Findings

Chapter Four presents the statistical findings obtained from analysis of the National Perinatal Data set (NPD) 2012 and the Monash Health Birthing Outcomes System (BOS) 2014. Synthesis of the key findings from both data sets, including a comparative summary table, is presented.

Chapter Five: Discussion

Chapter Five presents a synthesis of the findings with reference to the international literature. Discussion of the important factors and issues identified through the conduct of this study are examined. Limitations associated with this study and the use of large data sets collected for another purpose are outlined.

Chapter Six: Conclusion and Recommendations

Chapter Six summarises the main findings and implications of the study. Recommendations for maternal and perinatal practice, policy, and research are put forward.

1.12 Chapter Summary

This chapter has provided an overview of the context for study and an overview of the problem under investigation. The research aim and purpose has been outlined. The current study involves the comparison of perinatal outcomes across three groups of women: Indian-born, Australian-born, and Other overseas-born mothers. Definitions of key terms used in this study have been included in addition to a summary of the structure of the thesis.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter one presented the background and context for this study. This chapter reviews the factors associated with an increased risk for adverse perinatal outcomes. The population group of interest in this study are Indian-born mothers living and giving birth in India and outside India. The term 'Indian' in this review refers to people originating from the Indian subcontinent i.e. India, Pakistan, Bangladesh, and Sri Lanka (Agyemang & Bhopal, 2002).

The review of the literature has been undertaken in two parts. Part 1 includes a narrative review of the literature describing risk factors for adverse perinatal outcomes. Part 2 involves a scoping review describing perinatal outcomes for Indian-born mothers.

2.2 Part 1: Narrative Review

A narrative review involves the collection and appraisal of peer reviewed literature on the topic in order to describe the phenomena as a whole (B. N. Green, Johnson, & Adams, 2006; Kirkevold, 1997). Narrative reviews of health related problems enable the analysis of broad ranging evidence pertinent to the topic, including practice protocols and guidelines for professional practice (B. N. Green et al., 2006). Studies conducted in the last decade reporting on risk factors for adverse perinatal outcomes have identified country and place of birth, and access to appropriately skilled maternity care professionals, as factors to be considered (Alexander, Wingate, Mor, & Boulet,

2007; Anderson, Sadler, Stewart, Fyfe, & McCowan, 2013; M. L. Davies-Tuck et al., 2017; De Graaff, Wijs, Leemaqz, & Dekker, 2017; Reddy et al., 2017). Partial findings from the Global Survey on Maternal and Perinatal Health of the World Health Organization (WHO), which reports increased risk for adverse perinatal outcomes in 23 developing countries in Africa, Asia, and Latin America, have been included in this review (Ouyang et al., 2013).

2.3 Search Strategy

This literature review was conducted in 2014 and revised in 2018 to identify the risk factors for adverse perinatal outcomes for Indian-born mothers living inside and outside Australia. The search demonstrated a paucity of literature in the area of risk factors for adverse perinatal outcomes specifically related to Indian-born mothers internationally, and there were no relevant publications about Indian-born mothers' perinatal outcomes in Australia.

The initial search strategy (see Table 1) resulted in 2,108 general studies related to risk factors for perinatal outcomes involving a wide range of population groups. Following a rigorous review process, informed by the JBI approach to conducting a systematic review (Peters et al., 2015), exclusion criteria were applied. Exclusion criteria included the need for published literature to address risk factors for perinatal outcomes for Indian-born mothers specifically.

Table 1: ***Parameters for Literature Review***

Databases searched	MEDLINE Ovid, CINAHL, EMBASE, Scopus, PsychINFO, ProQuest, Google Scholar and the Monash Research Repository.
Search terms	'India' or 'pregnancy' or 'pregnancy outcomes' or 'gestation' or 'placental abnormalities' or 'South-Asian' or 'Australia' or 'diabetes' or 'maternal obesity' or 'diet' or 'malnutrition' or 'health complications' or 'adverse' or 'women' or 'mothers' or 'socioeconomic status' or 'maternal medical condition' or 'placental ageing' or surveillance' or 'risk factors' or 'intrauterine status' or 'smoking'.
Parameters	Full text, English language, published after 2002
Excluded articles	Articles not directly focused on Indian-born mothers, perinatal outcomes

A PRISMA diagram (see Figure 2) illustrates the results of the search strategy once the exclusion criteria was applied. A total of 19 articles met the inclusion criteria for the narrative review. Sources of grey literature relating to maternity services, policies, government reports, and guidelines pertinent for this study were obtained through Google Scholar and included in the narrative review.

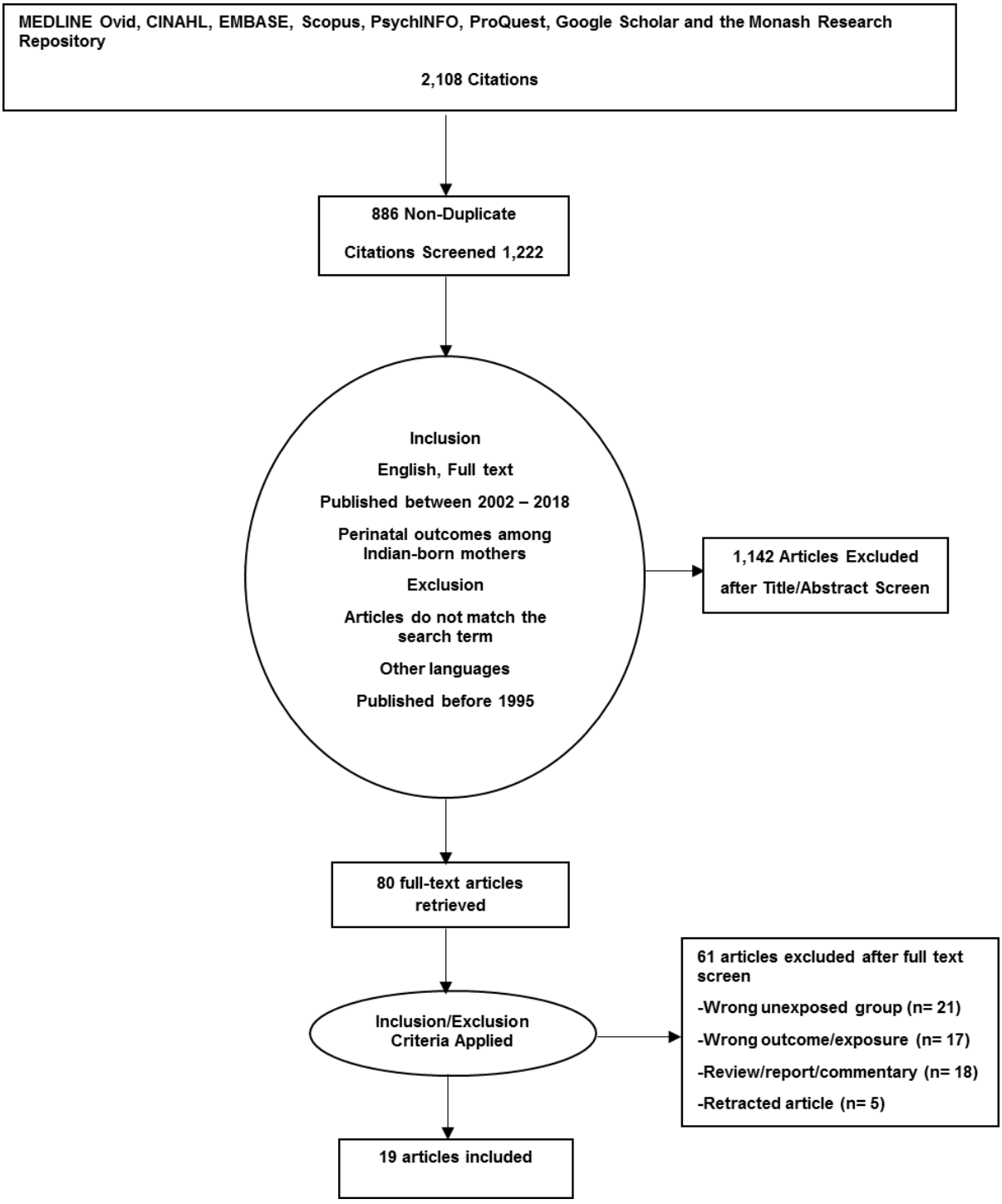

***Figure 2*: Literature Review Identification and Selection of Narrative Review Articles**

Table 2 : ***Description of Main Studies Selected***

Studies selected	Study involved risk factors for adverse perinatal outcomes for Indian-born mothers in Australia	Study involved risk factors for adverse perinatal outcomes for Indian-born mothers outside Australia
Slack, E., Rankin, J., Jones, D., & Heslehurst, N. (2018).		✓
Yim, C., Wong, L., Cabalag, C., Wallace, E. M., & Davies-Tuck, M. (2017).	✓	
de Graaff, E. C., Wijs, L. A., Leemaqz, S., & Dekker, G. A. (2017).	✓	
Reddy, M., Wallace, E. M., Mockler, J. C., Stewart, L., Knight, M., Hodges, R. & Davies-Tuck, M. (2017).	✓	
Flenady, V., Wojcieszek, A. M., Middleton, P., Ellwood, D., Erwich, J. J., Coory, M., & Lawn, J. E. (2016).	✓	
Blencowe, H., Cousens, S., Jassir, F. B., Say, L., Chou, D., Mathers, C. & Lawn, J. E. (2016).		✓
Martinson, M. L., & Reichman, N. E. (2016).		✓
Mridula, B., Small, R., & Davey, M. A. (2016).	✓	
Markovic, T. P., Muirhead, R., Overs, S., Ross, G. P., Louie, J. C. Y., Kizirian, N., ... & Brand-Miller, J. C. (2016)	✓	
Farrar, D., Fairley, L., Santorelli, G., Tuffnell, D., Sheldon, T. A., Wright, J., & Lawlor, D. A. (2015).		✓
Gibson-Helm, M., Boyle, J., Cheng, I. H., East, C., Knight, M., & Teede, H. (2015)	✓	
Bakken, K. S., Skjeldal, O. H., & Stray-Pedersen, B. (2015)		✓

Continued…

Table 2 *Continues*

Studies selected	Study involved risk factors for adverse perinatal outcomes for Indian-born mothers in Australia	Study involved risk factors for adverse perinatal outcomes for Indian-born mothers outside Australia
Bakken, K. S., Skjeldal, O. H., & Stray-Pedersen, B. (2015)		✓
Dahlen, H. G., Schmied, V., Dennis, C. L., & Thornton, C. (2013)	✓	
Drysdale, H., Ranasinha, S., Kendall, A., Knight, M., & Wallace, E. M. (2012)	✓	
Stein, C. R., Savitz, D. A., Janevic, T., Ananth, C. V., Kaufman, J. S., Herring, A. H., & Engel, S. M. (2009)		✓
George, K., Prasad, J., Singh, D., Minz, S., Albert, D. S., Muliyil, J., & Kramer, M. S. (2009)		✓
Harding, S., Rosato, M. G., & Cruickshank, J. K. (2004)		✓
Margetts, B. M., Yusof, S. M., Al Dallal, Z., & Jackson, A. A. (2002).		✓

2.4 Risk for Adverse Perinatal Outcomes

For the purposes of this current study, the WHO definition of perinatal period (WHO, 2018a) is used, which defines the period as commencing at 22 completed weeks (154 days) of gestation and ending seven days after birth. Risk factors associated with adverse perinatal outcomes include maternal medical conditions and sociodemographic status (Ota et al., 2014). Perinatal outcomes of interest in this current study include preterm delivery, low birth weight <2500 grams (A. K. Rao, Daniels, El-Sayed, Moshesh, & Caughey, 2006), stillbirths, Apgar score <7 at 5 minutes after birth, and neonatal death (J. E. Lawn et al., 2011; Liu et al., 2012).

Perinatal mortality rate (PMR) is a major marker of quality maternity care delivery (WHO, 2015). A standard computational method for calculating perinatal mortality rate involves the annual incidence of three defined events: stillbirths, neonatal deaths, and live births. The resulting proportion is expressed per 1,000 total births (AIHW, 2012). In Australia, the neonatal mortality rate has fallen to two per thousand births as compared to 29 per thousand births in India in 2013 (WBG, 2015), highlighting a major difference in women's perinatal outcomes.

Risk factors for adverse perinatal outcomes have been studied extensively for pregnant women as a group and have reported mixed findings (M. L. Davies-Tuck et al., 2017; Drysdale et al., 2012; Ota et al., 2014). The majority of studies have examined single risk factors for adverse perinatal outcome in order to observe cause and effect. For example, Macharey et al. found an increased risk of fetal growth restriction in neonates in the breech position delivered vaginally at term (Macharey et

al., 2017). This finding supports standard Australian practice guidelines for breech birth prescribing caesarean section delivery for babies who are breech at term (Alexandersson, Bixo, & Högberg, 2005; Dumont, De Bernis, Bouvier-olle, Bréart, & Group, 2001; H. C. Lee, El-Sayed, & Gould, 2008; Rietberg, Elferink-Stinkens, & Visser, 2005).

Demographic variables such as maternal age, parity, socioeconomic disadvantage, education, mother's nutritional status, illness and stress during pregnancy, domestic violence, and race or ethnicity have been reported to increase women's risk of complications in their pregnancy and associated adverse perinatal outcomes (Ashdown-Lambert, 2005). Participating in regular routine antenatal care has been proven to minimise these potential risks (Harper, Dugan, Espeland, Martinez-Borges, & McQuellon, 2007; Jordan & Murphy, 2009).

A limited number of studies have examined the risks for perinatal outcomes of Indian-born mothers as a specific immigrant group. In the current study, risks for adverse perinatal outcomes have been listed under the following headings: socioeconomic factors, maternal ethnicity, antenatal surveillance, pre-existing maternal medical condition, maternal overweight and obesity, reproductive risks factors, maternal smoking, and maternal age. The complexity of identifying risks is increased due to an overlap between these categories.

2.5 Relationship Between Socioeconomic Factors and Risk

International studies have identified socioeconomic factors of the individual or community as one of the most significant determinants for adverse perinatal outcomes (De Graaff et al., 2017; Dunn & Dyck, 2000; Mohsin, Bauman, & Jalaludin, 2006). Personal income is a reliable indicator of socioeconomic status (Lynch, Smith, Kaplan, & House, 2000). Personal income levels in India are low compared to international standards. The educated Indian migrant in Australia earns 10% of the average Australian income prior to immigration (ABS, 2017e). Indian migrants in Australia (2011-2012) represented 15% (147,642) of all taxpayers compared to 16% in the UK (ABS, 2017e). Evidence suggests that Indian migrants living and working in Australia are low to middle income earners.

Low income countries have increased incidence of adverse perinatal outcomes (Ota et al., 2014). Studies conducted in low income countries, including India, report that a mother's low socioeconomic status is associated with increased risks for low birth weight (Kader & Perera, 2014; S. P. Walker et al., 2007), small for gestational age, and preterm birth (Agyemang et al., 2009; Dibben, Sigala, & Macfarlane, 2006). This claim is supported by an Indian study which examined the association between low socioeconomic status and maternal health inequity during pregnancy, reporting that rural mothers in India experienced increased rates of adverse perinatal outcomes (Dwarkanath et al., 2018). This is also true in the Australian context, involving socioeconomically disadvantaged indigenous mothers compared with non-indigenous mothers (Mohsin et al., 2006). The disadvantage is associated with poor educational achievements leading to poor employment prospects, and resulting in lower family living standards.

Migration from a low income country to a higher income country is not enough to overcome the risk of adverse perinatal outcomes (Binder, Johnsdotter, & Essén, 2012). Migration has been identified as a contributing factor for socioeconomic disadvantage involving South Asian-born mothers, and associated with increased rates of stillbirth and low birth weight (Harper et al., 2007; Jordan & Murphy, 2009). Immigrants to the US from South Asia, specifically from India, have been reported to experience an increased rate of low birth weight (Hayes et al., 2008; Madan et al., 2006). This is despite their education and higher pre-immigration socioeconomic level (Alexander et al., 2007; Gould, Madan, Qin, & Chavez, 2003). The increased risk has usually been studied in relation to factors associated with migration, such as socio-demographic changes, lack of English, health literacy, and poor access to care (Lawn et al., 2016). It has been suggested that migration results in decreased socioeconomic status and is, therefore, associated with an increase in adverse perinatal outcomes (Cacciani et al., 2011).

The findings that South Asian Indian-born mothers continue to experience an increased risk for adverse perinatal outcomes following immigration to affluent Western countries is an unexplained phenomena impacting maternity care worldwide.

2.6 Maternal Ethnicity

Ethnic differences in health outcomes have been demonstrated in common health problems, including diabetes, cardiovascular disease, and cancer (Kheirandish & Chinegwundoh, 2011). Asian ethnicity in particular has been associated with increased risk of gestational diabetes mellitus (Abate & Chandalia, 2001; A. K. Rao,

Daniels, et al., 2006). Maternal ethnicity has been associated with increased risks of adverse perinatal outcomes despite receiving the same maternity care as other women (Abell & Teede, 2017; M. Urquia et al., 2010). Australian researchers Dahlen et al. observed that the babies of South Asian Indian-born mothers had increased risks for low birth weight and stillbirth when compared with Australian-born mothers (H. G. Dahlen et al., 2013; M. L. Davies-Tuck et al., 2017). Paternal black fathers in the US are reported to be associated with an increased risk of preterm birth (Palomar, DeFranco, Lee, Allsworth, & Muglia, 2007). Therefore, the role that a father's ethnicity may play in increasing risks for adverse perinatal outcomes is a factor that must also be taken into consideration.

Studies involving migrant groups report that perinatal outcomes are associated with parental ethnicity and region of birth (M. L. Urquia et al., 2010). Ethnic disparities are reported to exist among migrated mothers with higher preterm birth rates compared with US-born mothers (Forna, Jamieson, Sanders, & Lindsay, 2003). Ethnic differences in birth weight has been identified early in pregnancy, irrespective of nutritional status (Kinare et al., 2010). In rural India, low birth weight has been diagnosed using sonography by the 18th week of gestation, a situation at variance to that of the European population (Kinare et al., 2010).

The findings published by the Hudson Institute (Hudson Institute of Medical Research, 2017) have recommended the need for standardised international guidelines to include routine late term fetal monitoring for Indian-born mothers. The single most important risk factor for adverse perinatal outcomes internationally is related to

preterm birth and low birth weight (Blencowe et al., 2013; Goldenberg, McClure, & Bann, 2007; Victora & Barros, 2001).

Asian ethnicity has been associated with increased risk of gestational diabetes mellitus, for which specific guidelines have been implemented by the Australasian Diabetes in Pregnancy Society [ADIPS]. ADIPS automatically classify women from Asian, Polynesian, Indigenous, and Middle Eastern ethnic groups as at an increased risk of gestational diabetes mellitus (Hu, 2011; McElduff et al., 2005; Nguyen et al., 2012). This increased predisposition for acquiring gestational diabetes has been linked to findings from several international studies reporting that migrant Indians have an increased risk of developing type 2 diabetes (and related metabolic abnormalities) when compared to other ethnic groups (Abate & Chandalia, 2001). This finding is supported by US studies which have also reported that Indian or Pakistani women have increased risks of preterm delivery, gestational diabetes mellitus, and low birth weight at term (A. K. Rao, Daniels, et al., 2006).

2.7 Antenatal Surveillance

Routine regular antenatal appointments with a qualified maternity care professional in well-equipped facilities improve both maternal and fetal health (Carroli, Rooney, & Villar, 2001; Chung et al., 2009; Merlo et al., 2005; Warner, Musial, Chenier, & Donovan, 2004). Studies by Fox et al. state that weekly antenatal surveillance from 36 weeks until delivery reduces the incidence of adverse perinatal outcomes for women of advanced maternal age (Fox et al., 2013). Early detection of fetal growth restriction

in late pregnancy is a recommended practice for this group of mothers (M. L. Davies-Tuck et al., 2017).

Regular antenatal care is associated with early diagnosis of other health related needs such as family planning, tetanus, HIV and malaria prevention, immunization, screening for HIV and other infections, and detecting and caring for hypertensive disorders and gestational diabetes. Antenatal care visits are opportunities for pregnant women, especially for migrant women, to learn danger signs relating to hypertensive disorders and other pregnancy related complications, and to encourage newly migrated women to deliver at a hospital (Nikiéma, Beninguisse, & Haggerty, 2009; J Zupan, 2002; Jelka Zupan, 2005).

In a UK study examining the risks for antepartum stillbirth, Smith et al. reported that women should seek antenatal care as soon as they realize they are pregnant. Early antenatal care enhances timely information for the expectant mother on adequate nutrition during pregnancy and the risks associated with smoking and using other drugs (G. C. Smith et al., 2004). A Canadian study involving women aged 20 to 34 years who had minimal prenatal visits reported that poor emotional health prior to pregnancy was strongly associated with preterm birth (Tough et al., 2003). These findings concur with those of other authors that reduced antenatal care visits (<5) was associated with preterm and stillbirth (Kalanda, Verhoeff, Chimsuku, Harper, & Brabin, 2006; Krueger & Scholl, 2000).

Studies investigating the health of immigrants in the US report that the adverse health status of certain Asian and Pacific Islander mothers was related to inadequate access to formal medical care compared to native US mothers (Frisbie, Cho, & Hummer, 2001). The US does not provide universal access to maternity care, a situation which contributes to poor access to professional antenatal care for low income mothers. An Australian study (Yim, Wong, Cabalag, Wallace, & Davies-Tuck, 2017) reported that the majority of women from South Asian countries such as India, Pakistan, Bhutan, and Bangladesh living in Australia are highly exposed to low birth weight and stillbirth. Several authors have recommended further research to identify modifiable causal factors as an essential first step towards decreasing the incidence of adverse perinatal outcomes in Indian-born mothers (Elixhauser & Wier, 2011).

A recent systematic review was conducted by Yu (2012) to identify issues around antenatal screening and prenatal diagnostic testing for genetic disorders among women of Asian origin residing in western countries. The review concluded that the incidence of some birth defects was found to be increased in babies of Asian-born mothers. Also, Asian-born mothers in the UK and Australia were less likely to hold favourable attitudes toward antenatal screening and prenatal diagnosis. These differences were not found in the USA and Canada (Yu, 2012). Therefore, improving pregnant mothers' knowledge relating to the importance of routine antenatal care and to encourage antenatal care in early pregnancy is a first step in improving appropriately timed medical surveillance and screening (V. J. Flenady & Ellwood, 2012).

The Australian maternity service is renowned for the universal provision of high quality maternity care by qualified health professionals (McIntyre, 2012). Australian antenatal care is provided according to antenatal care guidelines which ensure that every pregnant woman receives the same standard of care (Bailey, 2017). Of all mothers who gave birth in 2012 in Australia, 99.9% of mothers had at least 1 antenatal visit and 95% of mothers had more than 5 antenatal visits (Hilder, Zhichao, et al., 2014). Consequently, the finding that South Asian Indian-born mothers continue to experience adverse perinatal outcomes when being cared for by maternity experts in Western countries is an unexplained dilemma for maternity care worldwide.

2.8 Relationship Between Pre-existing Maternal Medical Conditions and Increased Risks

Pre-existing maternal medical conditions have been found to be associated with increased adverse perinatal outcomes. A cross-sectional study undertaken in India examined the association between maternal nutritional status, body composition, and socio-economic status with low birth weight (LBW), reporting that maternal age, height, weight, nutritional status, birth order, and household income have a significant association with adverse perinatal outcomes, especially low birth weight (J. Sen, Roy, & Mondal, 2010). The most important determinant of birth weight is reported to be associated with maternal nutritional status (Dharmalingam, Navaneetham, & Krishnakumar, 2010; Muthayya, 2009; Ramakrishnan, 2004).

2.8.1 Nutritional Status (Anaemia)

The official threshold for anaemia is reached “when the haemoglobin level is less than 110 grams per litre at sea level” (WHO, 2017). The prevalence of anaemia among pregnant women in 2016 in Australia is 20.1% compared to 50% in India (WBG, 2018). In India, 40% of maternal deaths are directly or indirectly related to anaemia (N. Gupta et al., 2017). The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) have reported that migrants and refugee mothers have an increased exposure to anaemia related adverse health outcomes compared to Australian-born mothers (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2018).

Anaemia as a complication during pregnancy is unique among Indian-born mothers, and associated with babies who are small-for-gestational-age (Kurtyka et al., 2015). The common cause of anaemia in India involves iron and vitamin B12 dietary deficiencies (A. Sharma, Patnaik, Garg, & Ramachandran, 2008; Yajnik et al., 2008). Low dietary vitamin B-12 intake in the presence of high total folate intake is a marker of adverse birth outcomes for Indian mothers (Dwarkanath et al., 2013). Also, low dietary intake of iron (less than 20mg/day), malaria, and hookworm infestations are all associated with maternal anaemia (K. M. Rao, Balakrishna, Arlappa, Laxmaiah, & Brahmam, 2010; Toteja & Singh, 2004).

Maternal anaemia during pregnancy is associated with poor intrauterine fetal growth and increased risk of preterm birth and low birth weight (Kalaivani, 2009). An intervention study conducted in India reported that iron and folic acid supplements

reduce the incidence of anaemia at 16 to 20 weeks gestation, with an associated increase in mean birth weight (Agarwal, Agarwal, Sharma, & Sharma, 2006). In contrast, an earlier Maternal Nutrition Study conducted in Pune in rural India reported that a nutrient rich dietary intake during pregnancy was not associated with increased birth weight (S. Rao et al., 2001; Yajnik et al., 2003). These findings concur with those reported in a Dutch famine study between 1944-1945 which found no significant difference in neonates' birthweight before and after famine (A. D. Stein, Zybert, Van de Bor, & Lumey, 2004).

Scant Australian studies have reported on the relationship between dietary supplements and birthweight among Indian-born mothers. Those that do, report that Indian-born mothers are more prone to iron deficiency anaemia (R. Fernandez, Rolley, Rajaratnam, Everett, & Davidson, 2015). The nutritional status of Indian-born mothers after migration to Australia is unclear. It is, therefore, necessary to assess the nutritional level of Indian-born mother before, during, and after pregnancy.

2.8.2 Hypertensive Disorders and Pre-eclampsia

Pregnancy induced hypertension is defined as 'elevated blood pressure' occuring after 20 weeks of gestation in a mother with a history of normal blood pressure (L. A. Magee et al., 2014). Mothers who develop hypertension during pregnancy are at an increased risk of developing pre-eclampsia (Irgens, Roberts, Reisaeter, Irgens, & Lie, 2001). An increase in the incidence of maternal hypertensive disorders in pregnancy have been reported (Swati Singh, Ahmed, Egondu, & Ikechukwu, 2014), such as pregnancy-induced hypertension and pre-eclampsia/eclampsia. Pregnancy-induced

hypertension and pre-eclampsia/eclampsia increase the risks of preterm delivery, low birth weight, intrauterine growth retardation, asphyxia, and perinatal death (Ayaz, Muhammad, Hussain, & Habib, 2009; Kusiako, Ronsmans, & Van der Paal, 2000).

Pre-eclampsia is a condition during pregnancy, characterized by hypertension and proteinuria, that can be life threatening in its most severe form (Carr et al., 2009). Yet the disease mechanism remains unclear. It is known that placental production of an unknown substance, in combination with an exaggerated inflammatory response, leads to dysfunction in the maternal vascular endothelial cells which line blood vessels (Collins, Stevenson, Noble, Impey, & Welsh, 2012; Impey & Child, 2012, p. 175). A relationship between maternal and paternal ethnicity is also reported to be associated with increased rates of pre-eclampsia (Caughey, Stotland, Washington, & Escobar, 2005). The estimated risk of perinatal death with pre-eclampsia is about 13%, increasing to 28% if the mother develops eclampsia in developing countries (Jelka Zupan, 2005). Delivery of the fetus is the only way to treat pre-eclampsia (Impey & Child, 2012) .

Roberts et al., in a large population based study between 2000 and 2002 in New South Wales, reported that one in ten women suffers from a hypertensive disorder in pregnancy (Roberts, Algert, Morris, Ford, & Henderson-Smart, 2005). Also, in America, when compared to Caucasian women, African-American women had an increased risk of pre-eclampsia, whereas Latin and Asian women had a decreased risk (Caughey et al., 2005). Mothers with chronic hypertension also have three times the risk for adverse perinatal outcomes compared to the general US population

(Bramham et al., 2014). Moreover, Australian-born mothers have an increased rate of 6.8% for hypertensive disorders during pregnancy compared to 3.5% in South Asian-born mothers (Drysdale et al., 2012). Hypertensive disorder in pregnancy is common in rural populations in India (Bangal, Giri, & Mahajan, 2011). The increasing prevalence of hypertensive disorders of pregnancy (HDP) in developing countries are exacerbated by limited detection and treatment (Imdad, Jabeen, & Bhutta, 2011). Indian-born mothers appear to be at a decreased risk for hypertensive disorders compared to other ethnic groups in Australia and the US.

2.8.3 Gestational Diabetes Mellitus

Elevated blood glucose levels during pregnancy for women with no previous diagnosis of diabetes is defined as gestational diabetes mellitus (Setji, Brown, & Feinglos, 2005). Diabetes in pregnancy is associated with increased interventions in labour, birth and preterm delivery (AIHW, 2010; Akinci, Celtik, Yener, & Yesil, 2010; Bellamy, Casas, Hingorani, & Williams, 2009; Fadl, Östlund, Magnuson, & Hanson, 2010; Reece, 2010; Vangen et al., 2003). The disease is associated with perinatal complications, including respiratory problems (Reece, 2010; Yogev & Visser, 2009), macrosomia (Langer, Yogev, Most, & Xenakis, 2005; Reece, 2010), increased risks for caesarean section delivery, congenital malformations (Bener, Saleh, & Al-Hamaq, 2011; Schneider et al., 2011), and stillbirth (V. Flenady, Middleton, et al., 2011; Langer et al., 2005; Wood, Jick, & Sauve, 2003). A fetus with macrosomia (significant size) is at increased risk for birth complications such as shoulder dystocia and emergency caesarean section delivery, and is associated with the need for resuscitation and admission to neonatal intensive care (Frank, Frisbie, & Pullum, 2000; Goldberg, Hyslop, Tolosa, & Sultana,

2003; Ju, Chadha, Donovan, & O'Rourke, 2009; Vidarsdottir, Geirsson, Hardardottir, Valdimarsdottir, & Dagbjartsson, 2011).

Existing evidence states that early diagnosis and adequate medical management of gestational diabetes mellitus improves pregnancy outcomes for both mother and fetus through the reduction of pregnancy related complications (Crowther et al., 2005; Gonzalez-Quintero et al., 2007). South Asian immigrant mothers are reported to be at increased risk for acquiring gestational diabetes (Forna et al., 2003; Vangen et al., 2003). In an American study, Asian Indians, Filipina, Pacific Islander, Chinese, Mexican, and non-Hispanic Caucasian women who were born outside the US were associated with a higher risk for developing gestational diabetes mellitus than native born women (Hedderson, Darbinian, & Ferrara, 2010). This finding was supported in an earlier study reporting that the gestational diabetes rate in pregnant Asian women was shown to be 5–10 times that in Causcasian women (Chawla, Amundsen, Hanssen, & Iversen, 2006). In the UK, the frequency of gestational diabetes in a multiracial antenatal clinic reported an incidence of 3.5-7.3% in Asian women, and 4.4% in Indian women (Langer et al., 2005).

Asian Australians and Indigenous Australians are known to have increased risk for developing type 2 diabetes compared to Caucasian Australians (Thow & Waters, 2005). An Australian study found that Indian-born mothers have a higher incidence of developing gestational diabetes mellitus compared with other mothers (Carolan, Steele, & Margetts, 2010). The prevalence of gestational diabetes mellitus increased by 45% in Australia between 1995-2005, from 3.0% to 4.4%. South Asian mothers had

a higher rate of prevalence compared to Australia-born mothers (Anna, Van Der Ploeg, Cheung, Huxley, & Bauman, 2008). Despite mothers diagnosed with gestational diabetes receiving high standard medical care, the incidence of associated adverse perinatal outcomes remains higher for Indian-born mothers (Skupien, Cyganek, & Malecki, 2014).

2.8.4 Placental Factors

The role of placental function is considered a new, ground-breaking focus for research investigating unexplained adverse perinatal outcomes. Studies have reported that an association between placental ageing and impairment in placental function may result in fetal growth abnormalities and stillbirth (Bukowski et al., 2017; Chaiworapongsa et al., 2017). There is some evidence that different ethnic groups have different placental characteristics that may predispose them to early placental aging or impairment (Dombrowski, Berry, Johnson, Saleh, & Sokol, 1994; Perry, Beevers, Whincup, & Bareford, 1995; Williams, Evans, & Newnham, 1997).

Recent Australian studies report that placenta aging during pregnancy in Indian-born mothers results in the inability to meet the increasing metabolic needs of the placenta at the term and beyond, thereby increasing the rates of stillbirth (Belihu, Davey, & Small, 2016; M. Davies-Tuck, Wallace, & Davey, 2017). Extending this theory, Australian researchers have studied the placentas belonging to mothers with stillborn babies. They have reported that the length of placental telomeres in pregnancies that result in stillbirth are two times shorter in South Asian pregnant women born in India, Bangladesh and Pakistan than in cases of Australian-born women who successfully

gave birth to healthy babies. Shorter telomeres are associated with the rapid cellular ageing process (M. Davies-Tuck et al., 2017). This finding may explain why women born in India, Pakistan, and Bangladesh frequently go into labour one week earlier than Australian-born women (M. L. Davies-Tuck et al., 2017). Researchers are not able to explain why telomeres are shorter in the placentas of South Asian-born mothers at this point of time, but the finding is considered significant.

A study in Victoria, Australia, found that mothers born in India, Pakistan, Sri Lanka, Afghanistan and Bangladesh had a 1.5% increased chance of stillbirth at the end of their pregnancy (known as a “term stillbirth”) compared with women born in Australia or New Zealand (Miranda Davies-Tuck, 2017). Further research is required to better understand the mechanisms that contribute to these increased rates (Miranda Davies-Tuck, 2017). A number of screening tests have been developed that measure placental function, but these are not routinely used. Placental volume measurement and three-dimensional blood flow assessment represent two possible screening options (Kellow & Feldstein, 2011). Specialised ultrasound scanning capable of detecting placental abnormalities such as velamentous cord insertion, single umbilical artery, and placental volume during pregnancy are also an option (Arleo, Troiano, da Silva, Greenbaum, & Kliman, 2014).

International researchers agree that further studies of placental function are required to better understand the causes of unexplained stillbirth (Aviram & Kidron, 2010; Kidron, Bernheim, & Aviram, 2009; Roescher, Timmer, Erwich, & Bos, 2014) and to reduce fetal death (Dutton et al., 2012; M. Moran & McAuliffe, 2011; Warrander et al.,

2012; Warrander & Heazell, 2011). Indian-born mothers have increased risk for stillbirth which may be due to early placental ageing and placental dysfunction (M. Davies-Tuck et al., 2017).

2.8.5 Polycystic Ovary Syndrome (PCOS)

Polycystic ovary syndrome (PCOS) is an endocrine hormonal disorder affecting 12-18% of reproductive age women (Asgharnia, Mirblook, & Soltani, 2011). It affects 21% of Indigenous women in Australia and South Asian women (J. Boyle, Cunningham, Norman, Dunbar, & O'Dea, 2015; J. A. Boyle, Cunningham, O'Dea, Dunbar, & Norman, 2012; S. Davis et al., 2002; March et al., 2009). The cause of PCOS is unclear, but evidence indicates that genetic and environmental factors are associated with PCOS (Barthelmess & Naz, 2014). It is suggested that women with PCOS have an increased risk for adverse perinatal outcomes such as gestational diabetes, pre-eclampsia and preterm birth (Boomsma et al., 2006; Roos et al., 2011).

Studies conducted in India report the prevalence of PCOS in women ranges from 9.13% to 36%, being more common among adolescents (Nair et al., 2012; Nidhi, Padmalatha, Nagarathna, & Amritanshu, 2011). On the other hand, the prevalence is 6.3% among reproductive women in Sri-Lanka (Kumarapeli, Seneviratne, Wijeyaratne, Yapa, & Dodampahala, 2008), around 5.6% in China (R. Li et al., 2013), and 8.0% among African Americans in the US (Azziz et al., 2004). It has also been reported that PCOS is more common among women with type 2 Diabetes Mellitus (Park et al., 2003).

Treatment of PCOS is dependent upon the individual, and dependent on the presence of other metabolic disorders (Bargiota & Diamanti-Kandarakis, 2012). It is widely reported that women with diagnosed PCOS have increased rates of infertility, requiring assisted reproductive technology to achieve a pregnancy (Boomsma et al., 2006; Heijnen et al., 2005). Early diagnosis and treatment for PCOS is recommended for young women of reproductive age who wish to have a family in the future.

2.8.6 Other Medical Conditions

This section describes the association of other maternal medical conditions and the burden of infections contributing to adverse perinatal outcomes.

A significant proportion of perinatal morbidity and mortality in developing countries like India is related to maternal infections such as malaria (Goldenberg & Thompson, 2003; Gravett, Rubens, & Nunes, 2010; Guyatt & Snow, 2004; Kulmala et al., 2000; Van Geertruyden, Thomas, Erhart, & D'Alessandro, 2004; Watson-Jones et al., 2007), syphilis (Goldenberg & Thompson, 2003; Gravett et al., 2010; Watson-Jones et al., 2002; Watson-Jones et al., 2007), urinary tract infection (Jain, Das, Agarwal, & Pandey, 2013) and HIV-infection (Brocklehurst & French, 1998; Goldenberg & Thompson, 2003). Early detection and prophylaxic antibiotic treatment is necessary to decrease the onset of maternal and neonatal bacterial infection and sepsis (Hofmeyr & Smaill, 2002; Schrag et al., 2000; Seale, Mwaniki, Newton, & Berkley, 2009).

In India, 2-10% of all women suffer from asymptomatic bacteremia (ASB) (Schnarr & Smaill, 2008; Teppa & Roberts, 2005). This is the most common bacterial infection

affecting Indian women during pregnancy, and is associated with preterm labor, low birth weight, and intra uterine growth retardation (Jain et al., 2013). Evidence indicates that routine screening and treatment of ASB would enhance maternal and newborn health (Jain et al., 2013).

HIV continues to be a problem in developing countries such as India and Africa. An study conducted in Africa reported that pregnant African women who are either antiretroviral (ARV)-naive or on highly active antiretroviral therapy (HAART) were found to have infants with low birth weight (Ekouevi et al., 2008; Habib et al., 2008). In contrast, an Indian study reported that HIV positive pregnant Indian mothers were at no greater risk for low birth weight (Patil et al., 2011).

Thyroid disease such as hypothyroidism is reported to be increasing in incidence in the general population in India (14.3%). Pregnant women make up a significant proportion of this rate, the majority of whom present with subclinical disease (Lao, 2005; Rashid & Rashid, 2007). Hypothyroidism in pregnancy is associated with significantly increased risks of preterm delivery, fetal distress, and intrauterine growth retardation (Ajmani et al., 2014; Sahu, Das, Mittal, Agarwal, & Sahu, 2010). Early diagnosis of the disease is essential for optimal outcomes for mother and baby. Universal screening for thyroid dysfunction is recommended to prevent adverse perinatal outcomes.

2.9 Maternal Overweight and Obesity

The prevalence of obesity has increased worldwide, including in Australia. Obesity is defined as “having a body mass index ≥ 30”, and overweight is defined as “having a body mass index ≥25” (WHO, 2018b).

Body mass index: Body mass index (BMI) is a height to weight ratio used as a standard measure of a healthy person. A person who has a BMI > 28 is classified as being overweight. It is calculated as weight divided by height squared (kg/m^2) (Flegal, Carroll, Kit, & Ogden, 2012).

The recent Australia national survey (2014-15) reported 63.4% of the adult Australian population as overweight or obese (ABS, 2017d). Cardiovascular and metabolic disorders are associated with obesity, which may lead to medical complications during pregnancy (Jirojwong, Brownhill, Dahlen, Johnson, & Schmied, 2017). Maternal obesity rates are increasing reportedly affecting 19% of all mothers who gave birth in Australia in 2013 (AIHW, 2015, p. 17). Pregnant women in Australian are reported to have an increased pre-pregnancy and gestational weight gain (GWG) compared to previous generations of mothers. This increase predisposes them to pregnancy and birth complications (Dodd, Grivell, Nguyen, Chan, & Robinson, 2012). An elevated pre-pregnancy body mass index, paired with excessive gestational weight gain during pregnancy, has been shown to double the chance of premature birth (Dietz et al., 2006), pre-eclampsia, and caesarean section delivery (Raatikainen, Heiskanen, & Heinonen, 2006). An rise in pre-pregnancy weight and GWG has increased the incidence of obstetric complications such as mal-presentation, uterine rupture, cord

prolapse or compression, and fetal blood loss (Kabakyenga, Östergren, Turyakira, Mukasa, & Pettersson, 2011; Tachiweyika et al., 2011).

Maternal obesity has been observed more frequently in Asian and African migrants, who have been found to experience an increase in their weight after migrating to Australia (Schultz, Austin, & Letcher, 2009). Australian and UK studies have reported that obesity in South Asian-born mothers is a risk factor for adverse perinatal outcomes (Oteng-Ntim, Kopeika, Seed, Wandiembe, & Doyle, 2013; Penn, Oteng-Ntim, Oakley, & Doyle, 2014), including premature birth, low birth weight, or stillbirth (Carmichael et al., 2015; McBain, Dekker, Clifton, Mol, & Grzeskowiak, 2016). South Asian pregnant mothers are also reported to have an increased risk of miscarriage, gestational diabetes mellitus, prolonged pregnancy, and pre-eclampsia (Marchi, Berg, Dencker, Olander, & Begley, 2015; Oteng-Ntim et al., 2013).

The association between migration and BMI is well identified in systematic reviews, which report an higher abdominal adipose tissue, even at lower body mass index, among migrated Asian Indian-born mothers (P. N. Singh et al., 2014) when compared to those living in India (R. Fernandez, Miranda, & Everett, 2011). Also, migrated Asian Indian-born mothers have increased BMI (R. Fernandez et al., 2011), which has been suggested as a cause for an increased risk in adverse pregnancy outcomes. Interestingly, a recent study reported that South Asian women with lower BMI are at increased risk of gestational diabetes mellitus compared to Caucasian women (Slack, Rankin, Jones, & Heslehurst, 2018). It is clear that in order to best achieve a healthy pregnancy outcome, pregnant women must maintain a normal BMI (Diouf et al., 2011;

Han, Mulla, Beyene, Liao, & McDonald, 2011; McDonald, Han, Mulla, & Beyene, 2010). Evidence suggests that Indian-born mothers become obese only after migration to Australia (Schultz et al., 2009) and that weight management before and after pregnancy would reduce risks for adverse perinatal outcomes (Slack et al., 2018).

2.10 Reproductive Risk Factors

2.10.1 Spontaneous Abortion

Spontaneous abortion, or miscarriage, is defined as "a clinically recognised pregnancy loss before 20th week of gestation" (Regan & Rai, 2000; Tulandi & Al-Fozan, 2011). Fetal death refers to pregnancy loss following 20 weeks of gestation. Fetal death may or may not be associated with spontaneous abortion preterm. Globally, advanced maternal age is considered a risk factor for spontaneous abortion (Andersen, Wohlfahrt, Christens, Olsen, & Melbye, 2000; Cleary-Goldman et al., 2005; de La Rochebrochard & Thonneau, 2002), in addition to multigravida status and a history of previous miscarriages (Christiansen, 1997; Christiansen et al., 2005).

Studies investigating recurrent pregnancy loss have reported an association between previous pregnancy loss through spontaneous abortion and preterm delivery. Findings suggest that previous spontaneous abortion increases the risk for premature rupture of membranes and preterm labour in deliveries before 32 weeks (Buchmayer, Sparén, & Cnattingius, 2004). Medda, Baglio, Guasticchi, and Spinelli report an increase in spontaneous abortion ratio among foreign-born mothers (213.8/1000 live births) compared to local residents in Italy (154.6/1000 live births) (Medda, Baglio, Guasticchi, & Spinelli, 2002). In contrast, Indian-born mothers in Australia are reported to be at an

increased risk for unexplained fetal death in late stage pregnancy (Drysdale et al., 2012). More research is required to determine the exact incidence of unexplained fetal death in utero for Indian-born mothers.

2.10.2 Inter-Pregnancy Interval

A reduced interval between pregnancies is reported to increase risk for adverse perinatal outcomes such as preterm birth, low birth weight, and small for gestational age (Conde-Agudelo, Rosas-Bermúdez, & Kafury-Goeta, 2007; Rousso et al., 2002). Studies (Hsieh et al., 2005; G. C. Smith, Pell, & Dobbie, 2003) have examined the risks associated with inter-pregnancy interval. An increased risk of preterm birth in women was reported for those with a shorter interval between pregnancies, particularly less than six months. This finding is supported by an Emirati study, which shows a short pregnancy interval is an identified risk factor for spontaneous preterm birth (Al-Jasmi et al., 2002). This finding is also consistent with those of a Greek study of the rural population of Romany involving Muslim women. These women had short intervals between pregnancies found to be associated with a higher risk for preterm birth (Dafopoulos et al., 2002). Conversely, longer inter-pregnancy intervals are also reported to be associated with increased risks of stillbirth and early neonatal death (Conde-Agudelo, Rosas-Bermúdez, & Kafury-Goeta, 2006; Stephansson, Dickman, & Cnattingius, 2003).

A recent meta-analyses reported that an inter pregnancy gap of less than 18 months and greater than 59 months is significantly associated with an increased risk for adverse perinatal outcomes (Conde-Agudelo et al., 2006; ul Haq et al., 2017). This

finding is consistent with a study of Michigan women reporting that inter-pregnancy interval of 18 to 23 months is associated with a decreased risk for adverse perinatal outcomes among both Caucasioan and Afro-American women (Klerman, Cliver, & Goldenberg, 1998; B.-P. Zhu, Haines, Le, McGrath-Miller, & Boulton, 2001). Limited literature is available relating to the spacing between births and associated outcomes for Indian-born mothers. Further research to measure the presence of this potential risk is required.

2.11 Maternal Smoking, Alcohol and Substance Abuse

The consumption of alcohol, drug abuse, and tobacco use during pregnancy have all been associated with an increased risk in adverse perinatal outcomes (Conner et al., 2016; NSW Health, 2014). The prevalence of tobacco, alcohol and substance abuse in Australia in 2013 was reported to involve 40% of Australians (who either smoked daily or drank alcohol), with 3.1% engaging in all three of these behaviours (AIHW, 2014).

***Smoking*:**

Smoking during pregnancy increases the risk for adverse perinatal outcomes such as small for gestation age, preterm birth (Bickerstaff, Beckmann, Gibbons, & Flenady, 2012), miscarriage, ectopic pregnancy, and low birth weight when compared to non-smoking mothers (Cnattingius, 2004; Jackson, Batiste, & Rendall -Mkosi, 200 Pringle et al., 2005; Tolosa & Saade, 2010; Vardavas et al., 2010). Studies also report that uneducated single mothers have an increased tendency to smoke during pregnancy (Smedberg, Lupattelli, Mårdby, & Nordeng, 2014).

Mendelson et al. states that smoking habits among pregnant women in Australia are risk factors for low birth weight and stillbirth (Mendelsohn, Gould, & Oncken, 2014). It has been shown that rates of smoking have increased in young Australian mothers, with nearly 37% of teenage mothers chain-smoking (Mendelsohn et al., 2014). An increased rate in smoking is also reported among Indigenous mothers, who account for 46.4% of mothers who smoke in pregnancy compared to 13.8 % of non-indigenous mothers in Australia (Hilder, Zhichao, et al., 2014).

It is of interest to note that smoking is uncommon for Indian-born mothers in general and, therefore, less likely to be a risk factor for adverse birth outcomes such as low birth weight when compared to other mothers (Hawkins, Lamb, Cole, & Law, 2008).

Alcohol:

Excessive alcohol consumption during pregnancy increases the risk for adverse perinatal outcomes such as birth defects, impaired fetal brain development, small for gestational age and low birth weight (Patra et al., 2011). Alcohol consumption is not common for India-born mothers. A study (Kelly et al., 2008) reports that 2.4% of Indian-born mothers drank alcohol during pregnancy compared to 11.1% of other mothers. A recent study reports that alcohol consumption during pregnancy is more prevalent in Australia and New Zealand than other countries (O'Keeffe et al., 2015).

***Substance Abuse*:**

Substance abuse during pregnancy is an important issue associated with increased risk of adverse perinatal outcomes such as low birth weight, preterm birth

(Baldacchino, Arbuckle, Petrie, & McCowan, 2014; Conner et al., 2016), small for gestational age babies, placental abruption, intrauterine growth retardation, and stillbirth (Maeda, Bateman, Clancy, Creanga, & Leffert, 2014). Substance abuse is not common for Indian-born mothers (Hilder, Zhichao, et al., 2014). Indian-born mothers are reported to be non-smokers (Hawkins et al., 2008), and exhibit uncommonly low rates for alcohol and drug use compared to other mothers in Australia. Consequently low birth weight in Indian-born mothers is unlikely to be related to smoking and alcohol or drug intakes.

2.12 Maternal Age

Advanced Maternal Age Pregnancy:

Advance maternal age is commonly defined as “women giving birth to their first child at the age of 35 years and above” (Kenny et al., 2013). There is a growing trend of older mothers giving birth for the first time in high income countries such as Australia. In Australia in 2015, mothers who gave birth aged ≥ 35 increased to 22%, whereas mothers aged under 25 decreased to 15% (Australian Institute of Health and Welfare, 2017).

Advanced maternal age >35 years has been reported to have increased risks for adverse perinatal outcomes such as low birth weight, preterm birth, birth asphyxia, perinatal mortality, gestational diabetes, macrosomia, caesarean section birth, placenta praevia, miscarriage, an increase in admissions to neonatal intensive care units (Biro, Davey, Carolan, & Kealy, 2012; Carolan & Frankowska, 2011; Kenny et al., 2013; Laopaiboon et al., 2014; X.-l. Liu & Zhang, 2014; Ludford, Scheil, Tucker, &

Grivell, 2012), and small for gestational age neonate (Khalil, Syngelaki, Maiz, Zinevich, & Nicolaides, 2013).

In addition, mothers aged ≥35 have increased chances for developing common medical conditions such as heart disease, diabetes mellitus, and hypertensive disorders (Delbaere et al., 2007; Panagopoulos et al., 2006). Advanced maternal age alone is not an independent risk factor for adverse perinatal outcomes, but, in combination with other medical conditions such as obesity, diabetes and hypertension, the risk increases (Y. Wang, Tanbo, Åbyholm, & Henriksen, 2011). Advanced maternal age is also associated with higher rates of infertility, the use of reproductive technologies, and multiple gestations (Fretts, 2005; Klemetti, Gissler, Sainio, & Hemminki, 2014), all of which increase risk for adverse perinatal outcomes. It is estimated that advanced maternal age has contributed to more than 4,200 low birth weight babies and 2,800 stillbirths annually across all high income countries (V. Flenady, Koopmans, et al., 2011).

In developing countries, malnutrition, infection, and inadequate antenatal check-ups among advanced maternal aged mothers are reported to be associated with an increased rate of stillbirth (Ciancimino et al., 2014). An Australian systematic review between 2000 and 2010 reports stillbirth as a common adverse perinatal outcome for a maternal age between 34-49 years (Carolan & Frankowska, 2011). In addition, Alio et al. report that increased paternal age between 40-45 years contributes to an increased rate of 24% of stillbirth irrespective of maternal age (Alio et al., 2012).

***Teenage Pregnancy*:**

Teenage pregnancy is defined as a “mother childbearing between the ages of 13-19 years” (Ashok Kumar, Singh, Basu, Pandey, & Bhargava, 2007). The Australian Bureau of Statistics reports teenage pregnancies within an age range of 15–19. Teenage pregnancies in Australia in 2016 were reported to occur at a rate of 11 per 1,000 births (ABS, 2017b).

International researchers agree that teenage pregnancy is associated with increased risk for low birth weight (W. Gilbert, Jandial, Field, Bigelow, & Danielsen, 2004), pre-term birth (Jolly, Sebire, Harris, Robinson, & Regan, 2000), small for gestational age (Conde-Agudelo, Belizán, & Lammers, 2005) and neonatal mortality (W. Gilbert et al., 2004). In contrast, others studies, possibly limited to Western countries, have reported no association between teenage pregnancy and adverse perinatal outcomes (Bukulmez & Deren, 2000; G. C. Smith & Pell, 2001). Teenage pregnancy has been reported to be associated with life-long, low socio economic status (Klis, Westenberg, Chan, Dekker, & Keane, 2002; Susheela Singh, Darroch, & Frost, 2001). Australian researchers have reported that Indian-born mothers are less likely to be teenagers or of advanced maternal age compared to other mothers (H. G. Dahlen et al., 2013).

2.13 Narrative Review Summary

The narrative review has discussed findings from published studies exploring the risk factors for adverse perinatal outcomes for Indian-born mothers living in and outside India. There is a paucity of literature describing the risks for adverse perinatal outcomes for Indian-born mothers as a discrete group rather than as a small subgroup

within a larger population. Recent Australian studies have provided some evidence for the direction that future research in this area should take. The role of placental function and the link between placental aging and fetal growth in South Asian Indian-born mothers is an important but under researched area (M. Davies-Tuck et al., 2017).

2.14 Part 2: Scoping Review

The aim of this scoping review is to describe adverse perinatal outcomes for mothers in general and South Asian Indian-born mothers in particular. This scoping review reports current evidence on the following key variables including: perinatal mortality, perinatal outcomes, and low birth weight.

A search for peer-reviewed articles in a range of databases, including MEDLINE, CINAHL, Cochrane, and the Joanna Briggs Institute Database of Review and Implementation Reports was conducted. Boolean logic using AND, OR, and NOT to broaden the search, AND and NOT to narrow the search, truncation symbols and wildcards, synonyms, and keywords and phrases were integrated into the search after being identified through Medical Subject Headings (MeSH). The key words and "MeSH" terms used for the search included 'India', 'mother', 'pregnancy', 'birth outcomes', 'preterm', 'premature', 'low birth weight', 'small for gestational age', 'birth abnormalities', 'pregnancy outcomes', 'pregnancy complication', 'stillbirth', 'birth defect', 'fetal growth retardation', 'newborn', 'infant mortality', 'sepsis', 'hypoxia', and 'APGAR score at 5 minutes'.

2.15 Study Selection

Primary randomised and non-randomised quantitative studies, qualitative studies, and systematic reviews were included involving South Asian Indian mothers only, in any setting. Studies involving multiple ethnic groups where South Asian Indian mothers were a specified subgroup or comprised the majority of participants were also included. The inclusion criteria applied during the search was as follows: population (South Asian Indian mothers living in and giving birth in and outside India). Exclusion criteria are studies not related to South Asian Indian mothers. In this review, we will consider studies that evaluate the prevalence and/or related incidence factors (excluding nutritional deficiency) associated with adverse birth outcomes for South Asian Indian mothers living and giving birth in and outside India.

One reviewer (KB) independently screened titles and abstracts against the respecified eligibility criteria. A second reviewer (MM) then screened selected abstracts. Full-text articles were obtained and reviewed by both authors for studies that appeared to meet the eligibility criteria, or where eligibility could not be adequately judged. Disagreement was resolved by discussion among the two reviewers with a third reviewer consulted if deemed necessary. Study authors were not contacted for further information.

2.16 Data Abstraction

Data abstraction was conducted in duplicate by two authors (KB and MM) using a structured extraction form piloted on two studies. Disagreement was resolved via discussion. Each article was reviewed as per the inclusion criteria. The data extraction included study classifiers (reviewer name, lead author, date, country of origin,

publication type, and year), study characteristics (sample size, methods, study design, and subject characteristics), method of randomisation, type of intervention, aims, population, status in the review, outcomes, significance values, statistical method applied, and medical treatment. The extracted templates were summarized in Microsoft Word, and paper copies were manually completed for each study.

Employing a standardised data extraction tool from JBI-MAStARI for quantitative data and thematic analysis techniques, a combination of more inductive and deductive approaches were used to identify the articles and develop an overall interpretation (Fereday & Muir-Cochrane, 2006) of the literature from a population and adverse birth outcome perspective. The review process was conducted by two independent reviewers, who applied an iterative approach scoping review question and purpose. Exclusion criteria are studies not related to South Asian Indian mothers. Specific studies that identify related factors that increase the risk of adverse birth outcomes were considered.

Adverse perinatal outcomes (outcome measurements include: live birth, stillbirth, perinatal mortality, gestation term, prematurity, low birth weight, small for gestational age, fetal abnormality, intrauterine growth restriction) were grouped thematically into key topics that emerged from the review of the literature. Once established, these themes were presented and discussed narratively. No formal data synthesis or assessment of intervention effectiveness was undertaken. Quality appraisal of selected studies was not conducted as this is not typical of scoping reviews (Arksey &

O'Malley, 2005), but general limitations were discussed. In addition, no formal consultations were conducted with stake holders.

2.17 Literature Search

Selection for suitable articles for the literature review is represented in Figure 3. The original search on MEDLINE and CINAHL was undertaken, and followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe the article. The search yielded 2,106 potentially relevant publications. The original search was conducted in 2014 and updated in May 2017, and 96 more potentially relevant articles were identified. Also, the databases Science Direct, PsycINFO, and Scopus were added, of which 884 were duplicates. Of the remaining 1,222 articles, 946 articles were excluded as not being relevant to the topic. Of the remaining 276 titles and abstracts screened using inclusion criteria, 182 articles were excluded as not being related to the inclusion criteria. 94 studies that either appeared to meet all of the inclusion criteria, or in which it was unclear whether or not the study met the criteria, were retained for full review. 14 of these articles were excluded because they did not meet the inclusion criteria. Of the final 80 articles, 19 were deemed an incorrect unexposed group, 13 were incorrect because of the outcome/exposure, 17 articles reported irrelevant outcomes, and 5 articles were retracted articles. The remaining 26 articles were included in the review.

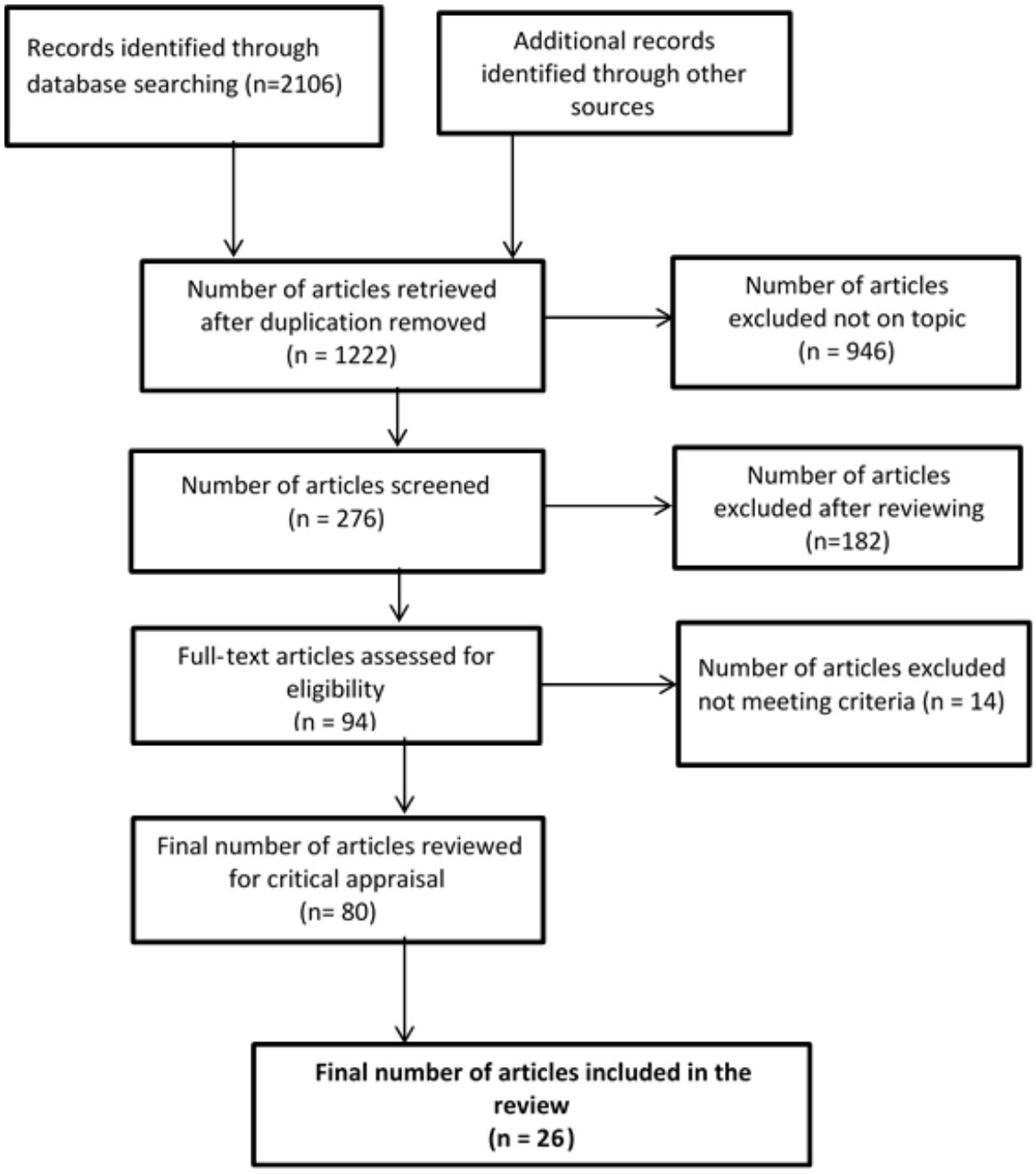

***Figure 3*: Flow Chart of Included and Excluded Studies**

2.18 Study Characteristics Scoping Review

The final 26 articles included in this review focus on South Asian Indian populations and discuss adverse birth outcomes in and outside India. As suspected, all the included studies were heterogeneous, and not South Asian Indian specific. However, they were initiated by Indians. Two studies were included from 1995 and 1997 since the interventions were operated within ethnic paradigms (Asian and Indian). In addition, their inclusion depicts pregnancy outcomes for Indian mothers outside India. Table 3 shows the final breakdown, including primary study characteristics, of research area, study populations, sample size, and study design. Table 4 summarises the included articles.

Study populations ranged in size from n=124 to n=9.1 million. The majority of studies were conducted in specific pregnancy and delivery population contexts. Thematic analysis techniques were applied by using a combination of inductive and deductive approaches to identify compositions beyond the articles, and develop an overall interpretation (Fereday & Muir-Cochrane, 2006) of the literature from a public health and population perspective.

Firstly, in order to understand the differences in perinatal outcomes among South Asian Indian mothers, we identified three categories that reflect the adverse perinatal outcomes:

(1) *Low Birth Weight*: (Agnihotri, Antonisamy, Priya, Fall, & Raghupathy, 2008; Ajmani et al., 2014; Alexander et al., 2007; Anuranga, Wickramasinghe, Rannan-Eliya, Hossain, & Abeykoon, 2012; Basu, Rathore, & Bhatia, 2008; Chakraborty & Anderson,

2011; Fuentes-Afflick & Hessol, 1997; Gould et al., 2003; P. Gupta, Nayan, & Sharma, 2012; P. C. Gupta & Sreevidya, 2004; Jain et al., 2013; Kinare et al., 2000; A Kumar, Chaudhary, & Prasad, 2010; Ashok Kumar et al., 2011; Leon & Moser, 2012; Madan et al., 2006; V. Patel & Prince, 2006; Patil et al., 2011; Pickett, Shaw, Atkin, Kiernan, & Wilkinson, 2009; A. K. Rao, Cheng, & Caughey, 2006; A. Sen et al., 2005; Viegas, Leong, Chia, Yeoh, & Ratnam, 1995).

(2) *Preterm Birth*: (Ajmani et al., 2014; Basu et al., 2008; Gould et al., 2003; P. Gupta et al., 2012; P. C. Gupta & Sreevidya, 2004; Jain et al., 2013; Koh et al., 2013; Ashok Kumar et al., 2011; Patil et al., 2011; Pickett et al., 2009; A. K. Rao, Cheng, et al., 2006; Rowan, Luen, Hughes, Sadler, & McCowan, 2009; Sahu et al., 2010; A. Sen et al., 2005; Viegas et al., 1995).

(3) *Stillbirth:* (Ajmani et al., 2014; M. L. Davies-Tuck et al., 2017; Rowan et al., 2009; Viegas et al., 1995).

We drew on the ways in which these three issues have been identified in previous literature to deduce adverse birth outcomes among South Asian Indian mothers inside and outside Australia. Though low birth weight (<2500 grams) is a frequently reported birth outcome in the literature, this classification often includes infants born small for gestation and intra uterine growth retardation. Study design included prospective cohort studies (Jain et al., 2013; Ashok Kumar et al., 2011; Pickett et al., 2009; Sahu et al., 2010), thematic analysis (Ajmani et al., 2014), qualitative surveys, interviews, comparative and focus groups (Agnihotri et al., 2008; P. C. Gupta & Sreevidya, 2004; Kinare et al., 2000; Koh et al., 2013; Patil et al., 2011; A. Sen et al., 2005), retrospective cohort studies (Alexander et al., 2007; Anuranga et al., 2012; Basu et

al., 2008; Chakraborty & Anderson, 2011; M. L. Davies-Tuck et al., 2017; Fuentes-Afflick & Hessol, 1997; Gould et al., 2003; Hayes et al., 2008; Leon & Moser, 2012; Madan et al., 2006; V. Patel & Prince, 2006; A. K. Rao, Cheng, et al., 2006; Rowan et al., 2009; Viegas et al., 1995), and a case control study (P. Gupta et al., 2012).

Most of the studies employed retrospective or survey-based techniques. Most of the outcomes, as such, are from secondary data. There are few direct experimental outcomes and few direct interview statements. Most of the included studies were conducted in India (Agnihotri et al., 2008; Ajmani et al., 2014; Basu et al., 2008; Chakraborty & Anderson, 2011; P. Gupta et al., 2012; P. C. Gupta & Sreevidya, 2004; Jain et al., 2013; Kinare et al., 2000; Ashok Kumar et al., 2011; Patil et al., 2011; Sahu et al., 2010; A. Sen et al., 2005), and dealt with adverse birth outcomes among Indian-born mothers (Agnihotri et al., 2008; Ajmani et al., 2014; Basu et al., 2008; Chakraborty & Anderson, 2011; P. Gupta et al., 2012; P. C. Gupta & Sreevidya, 2004; Jain et al., 2013; Kinare et al., 2000; Ashok Kumar et al., 2011; Patil et al., 2011; Sahu et al., 2010; A. Sen et al., 2005). Details of included studies are provided in Table 3.

2.19 Low Birth Weight

Low birth weight (LBW) has been defined as a “weight at birth of less than 2,500 grams”, as per the WHO guidelines (WHO & UNICEF, 2004). A baby’s low weight at birth is either the result of preterm birth (before 37 weeks of gestation), or as a result of restricted fetal (intrauterine) growth (WHO & UNICEF, 2004). The regional estimation of low birth weight reports a figure of 28% for South Asia (WHO, 2014). In Australia, in 2012, there were 19,243 (6.2%) live born babies of low birthweight. The

3,071 very low birthweight babies made up 1.0% of all live births in 2012, and the 1,299 extremely low birthweight babies made up 0.4% (Hilder, Zhichao, et al., 2014). Birth weight distributions and proportions of moderate low birth weight and low birth weight are commonly mentioned in twenty-three studies (Agnihotri et al., 2008; Ajmani et al., 2014; Alexander et al., 2007; Anuranga et al., 2012; Basu et al., 2008; Chakraborty & Anderson, 2011; Fuentes-Afflick & Hessol, 1997; Gould et al., 2003; P. Gupta et al., 2012; P. C. Gupta & Sreevidya, 2004; Jain et al., 2013; Kinare et al., 2000; A Kumar et al., 2010; Ashok Kumar et al., 2011; Leon & Moser, 2012; Madan et al., 2006; V. Patel & Prince, 2006; Patil et al., 2011; Pickett et al., 2009; A. K. Rao, Cheng, et al., 2006; A. Sen et al., 2005; Viegas et al., 1995).

A brief summary of these findings, results, and recommendations follows: Hayes et al. showed that infants of Indian and Chinese mothers had low birth weight differences among their babies, but both had been classified as Asian (Hayes et al., 2008). Results of this study also depict that infants of US-born Asian Indian mothers and infants of non-US born Asian Indian mothers were more likely to be of very low birth weight (VLBW) (AOR 1.87, 95% CI: 1.27–2.75), or moderately low birth weight (MLBW) (AOR 1,59, 1.39–1.82) and (VLBW) (AOR 2.13, 2.06–2.21) or (MLBW) (AOR 2.26, 2.18–2.35) when compared to infants of US-born Chinese mothers and non-US born Chinese mothers (Hayes et al., 2008). Indians outside of India in the US, a study by Rao et al. shows that Indian mothers attract a risk of low birth weight at term (adjusted odds ratio, 3.67) (S. Rao et al., 2001).

Among all the studies, the most common finding for an adverse perinatal outcome was low birth weight. Alexander et al. explicate that, in their study in the U.S, the average birth weight of Asian Indian American mothers is approximately 270 grams smaller than Caucasian mothers. They reported a statistically significant difference between race/ethnic groups. This study suggested that, regardless of ethnic group, very low birth weight and very preterm birth rates may be a sign of infant mortality (Alexander et al., 2007). It was reported that ethnicity played a major part in birth outcomes, with South Asian Indian-born mothers having an increased rate of low birth weight (Alexander et al., 2007; M. L. Davies-Tuck et al., 2017; Hayes et al., 2008; Leon & Moser, 2012; Madan et al., 2006; V. Patel & Prince, 2006; Pickett et al., 2009; A. K. Rao, Cheng, et al., 2006). Maternal birth weight also emerged as a significant predictor of offspring birth weight (Agnihotri et al., 2008).

Ten Indian studies reported on birth weight, each study indicating different factors for low birth weight among Indian mothers. Some of the non-significant findings showed that there was a higher prevalence of low birth weight (25 vs. 12.11 %) among thyrodism mothers than euthyroidism mothers (Ajmani et al., 2014). Also, an increased incidence of low birth weight (LBW) [RR1.37, 95% CI 0.71-2.61] was seen late in detected women (32-34 weeks), as compared to asymptomatic bacteriuria (ASB) negative women (Jain et al., 2013). Interestingly, there was no difference between HIV infected and uninfected pregnant women in neonatal parameters such as low birth weight (41% versus 22%, p0.002) (Patil et al., 2011). Additionally, the prevalence of positive serologic findings for celiac disease in Indian women show the rate of low birth weight infants was increased in seropositive women when compared with seronegative mothers (Ashok Kumar et al., 2011). Furthermore, in another study, the

non-significant findings reported that low birth weight rate was increased by 45% in pregnant mothers not treated with antimicrobial therapy for putative genital and urinary tract infections in comparison to the control group (A. Sen et al., 2005).

Guptha et al. report that low birth weight and neonatal complications were heavily confounded by preterm delivery and multiple pregnancies, the adjusted OR (odds ratio) being 0.9 and 1.0 respectively (P. Gupta et al., 2012). Low maternal autonomy was an independent predictor of low birth weight (OR 1.28, 95% confidence interval [CI] 1.07-1.53, p = 0.007) (Chakraborty & Anderson, 2011). Another study depicted that common antenatal and perinatal predictors of mortality in very low birth weight (VLBW) infants in India included maternal bleed, failure to administer antenatal steroids, low Apgar score, apnoea, extreme prematurity, neonatal septicaemia and shock (Basu et al., 2008). Agnihotri et al. found that the offspring birth weight is determined by both maternal and paternal birth weight. The chance of a low birth weight baby doubles (95%CI 1.2–6.4 p=0.02) & (OR 2.2; 95%CI 1.0–4.8; p=0.05) in the case of a low birth weight mother and father (Agnihotri et al., 2008). This study also revealed that parental birth weight is a strong predictor of offspring birth weight.

Further, maternal use of smokeless tobacco was associated with an average reduction of 105 grams in birth weight (95% confidence interval 30 grams to 181 grams). The odds ratio for low birth weight was 1.6 (1.1 to 2.4), adjusted by logistic regression for maternal age, education, socioeconomic status, weight, anaemia, antenatal care, and gestational age (P. C. Gupta & Sreevidya, 2004). Kinare et al. suggest that placental growth in early pregnancy is an important and independent predictor of fetal growth.

Mid pregnancy placental volume in Indian-born women was related to maternal pre-pregnant weight and independently predicted low birth weight (Kinare et al., 2000), but the study also found non-significant associations between Indian mothers and these outcomes.

2.19.1 Small for Gestational Age

Small for gestational age is defined as “a fetus or infant with growth parameters below the 10th percentile for gestational age” (Lohaugen et al., 2013).

Six studies reported on small for gestational age, intrauterine growth restriction (IUGR) or fetal growth restriction (FGR) (Alexander et al., 2007; Gould et al., 2003; Ashok Kumar et al., 2011; Madan et al., 2006; Rowan et al., 2009; Sahu et al., 2010). Three studies were undertaken in the United States. Alexander et al. reported that, in comparison to non-Hispanic Caucasian, Asian-Indian-Americans have the lowest percentage of births. Also, Asian-Indian-Americans had an increased rate of low birth weight, small-for-gestational age, and term SGA births, but infant deaths were only slightly increased from Caucasian levels and were far less than African-Americans (Alexander et al., 2007).

Gould et al. and Madan et al. reported that foreign-born Asian Indian mothers had higher levels of “growth retardation” births (Gould et al., 2003) and small for gestational age (Madan et al., 2006) than other mothers in the US, irrespective of their high socioeconomic status and early entry into maternity care. They also stated that genetic or environmental factors may increase for small for gestational age births among

foreign-born Asian Indian mothers. In addition, a New Zealand study found that increased morbidity in small for gestational age babies was associated with preterm birth (Rowan et al., 2009). Two Indian studies reported that the prevalence of thyroid dysfunction and celiac disease during pregnancy among Indian-born mothers in India resulted in increased intrauterine growth restriction (Ashok Kumar et al., 2011; Sahu et al., 2010).

2.20 Preterm Birth

Preterm birth is defined as “live birth before 37 completed weeks of pregnancy” (Ouzounian & Goodwin, 2010, p. 9; WHO, 2012), whereas a post-term pregnancy is one which has progressed to 42 weeks of completed gestation (Mullin & Miller, 2010). Preterm birth can be further sub-divided based on gestational age: extremely preterm (<28 weeks), very preterm (28–<32 weeks) and moderate preterm (32-<37 completed weeks of gestation). Moderate preterm birth may be further split to focus on late preterm birth (34-<37 completed weeks) (Blencowe et al., 2012). Of all deaths within the first seven days of life that are not related to congenital malformations, 28% are because of preterm birth (Lawn, Wilczynska-Ketende, & Cousens, 2006).

Sixteen studies reported on pre-term birth (Ajmani et al., 2014; Basu et al., 2008; P. Gupta et al., 2012; P. C. Gupta & Sreevidya, 2004; Hayes et al., 2008; Jain et al., 2013; Koh et al., 2013; Patil et al., 2011; Pickett et al., 2009; A. K. Rao, Cheng, et al., 2006; Rowan et al., 2009; Sahu et al., 2010; A. Sen et al., 2005; Viegas et al., 1995). In this group, eight studies from India reported that maternal factors like thyroid dysfunction (Ajmani et al., 2014; Sahu et al., 2010), asymptomatic bacteriuria during

pregnancy (Jain et al., 2013), maternal bleeding, and failure to administer steroids when premature delivery is anticipated were antenatal predictors of mortality (Basu et al., 2008). Mothers conceived by assisted reproductive techniques (P. Gupta et al., 2012) had low maternal autonomy (Chakraborty & Anderson, 2011), and mothers not having received any antenatal care prior to delivery had a heightened chance of pre-term delivery (Patil et al., 2011).

Pregnant mothers not treated with antimicrobial therapy for putative genital and urinary tract infections have higher rates of pre-term delivery (A. Sen et al., 2005). Maternal smokeless tobacco use is also associated with early preterm delivery (P. C. Gupta & Sreevidya, 2004). Two studies from Singapore report that Asian Indian mothers' gestational weight gain is associated with pre-term delivery (Koh et al., 2013), and that there is a variation amongst Asian ethnicities. Indian mothers were 1-5 times more likely to give birth preterm than Chinese and Malay mothers (Viegas et al., 1995).

Furthermore, a UK study showed that Indian ethnicity was associated with pre-term delivery (Pickett et al., 2009). A US study also revealed statistically significant differences exist between subgroups of the Asian-American and Pacific Islander community, in which Indian/Pakistani mothers had a higher rate of preterm delivery than others (A. K. Rao, Cheng, et al., 2006). In addition, a New Zealand study found that increased morbidity in small for gestational age babies was associated with preterm birth (Rowan et al., 2009).

2.20.1 Low Apgar Score

Apgar score is the sum of the five components (heart rate, respiratory effort, muscle tone, reflex irritability, and color), and is assessed immediately after birth to evaluate neonatal wellbeing (Casey, McIntire, & Leveno, 2001; Straube et al., 2010). The five-minute Apgar score has been shown to be a better predictor of survival in the neonate. A score of 7 out of 10 or higher indicates that the baby's condition is good to excellent. Low Apgar score, defined as “at 5 minutes Apgar <7”, is a commonly used indicator to determine asphyxia-related conditions (Kidanto, Massawe, Nystronr, & Lindmark, 2006). A low Apgar score (0–3) confirms that the neonate’s outcome is poor (Harrington, Redman, Moulden, & Greenwood, 2007). A low Apgar score may be a result of prematurity or congenital malformations, and is associated with increased risk of morbidity and mortality as a result of the consequences of brain hypoxia (Harrington et al., 2007; Kidanto et al., 2006). Furthermore, the Apgar score is a useful tool in identifying birth asphyxia (Casey et al., 2001).

Complications, such as premature rupture of membranes and obstructed/prolonged labour, increases the risk of neonatal morbidity and mortality in a setting with limited resources (Mmbaga, 2013; Weiner et al., 2003). A study by Dahlen et al. reported that immigrants from India are more likely to require assisted deliveries or a caesarean section compared to Australian-born mothers (H. G. Dahlen et al., 2013). Similarly, Asian-Indian mothers are reported to be at increased risk for prolonged second stage of labour and obstetric anal sphincter injury when compared to Caucasian women (Davies-Tuck et al., 2015; Greenberg et al., 2006; T. J. Rosenberg, Garbers, Lipkind, & Chiasson, 2005).

All these conditions may lead to asphyxia (lack of oxygen to the brain) of the newborn if emergency care is not administered (Edmond et al., 2008; Goldenberg et al., 2007; Kabakyenga et al., 2011; Kaye, 2004; Kusiako et al., 2000; Lawn et al., 2009; Mbaruku, van Roosmalen, Kimondo, Bilango, & Bergström, 2009; Tachiweyika et al., 2011; Weiner et al., 2003). Birth asphyxia occurs when there is an inadequate amount of oxygen delivered to the fetus during the birthing process, leading to risk of death (stillbirth or neonatal death) or brain damage in the surviving infant (Serra -Grabulosa et al., 2003).

A New South Wales study reported that immigrant Asian infants had the lowest 5 min Apgar scores seen in a neonatal intensive care unit, compared to other mothers in Australia (Uppal et al., 2013). A low Apgar score has been correlated with asphyxia, prematurity or congenital malformations, which are associated with increased risk of morbidity and mortality due to the consequence of brain hypoxia (Kidanto et al., 2006). There is some evidence that proper monitoring of labour in a setting with an emergency obstetric care will result in better outcomes in complicated labour (Darmstadt et al., 2009; Jammeh, Vangen, & Sundby, 2010; Kidanto et al., 2009; Mbaruku et al., 2009).

Three studies reported on low Apgar score (Basu et al., 2008; Koh et al., 2013; Sahu et al., 2010). One Indian study reported that women with hyperthyroid disease had a significance association with neonatal asphyxia, reporting cases of babies with Apgar score <7 at 5 minute at birth having been admitted to intensive neonatal care units (Sahu et al., 2010). Another study stated that low Apgar score between 1 and 5 min

<7 has been associated with poor neonatal outcomes (Koh et al., 2013). Basu et al. have further reported that an Apgar score ≤5 at one minute is a significant indicator for neonatal mortality (Basu et al., 2008).

2.21 Stillbirth

In Australia and New Zealand, a stillbirth is defined as “when a baby dies before or during birth and can occur at any time from 20 or more completed weeks of gestation, until full term (40 weeks) or later, or of 400 grams or more birthweight” (Australian Institute of Health and Welfare, 2017). In other countries, different weights and gestational age cut-offs apply. The definition of stillbirths, as recommended by WHO, is a baby born with no signs of life at or after 28 weeks gestation (WHO, 2016).

Three studies identified in this review explored the association between Indian ethnicity and stillbirth as a birth outcome (Ajmani et al., 2014; M. L. Davies-Tuck et al., 2017; Viegas et al., 1995). All reported that the maternal region of birth was associated with stillbirth. Women born in South Asia (aOR 1.27, 95% CI 1.01± 1.53, p = 0.01) were more likely to have a stillbirth compared to women born in Australia/New Zealand (M. L. Davies-Tuck et al., 2017). Also, Ajmani et al. found that thyroid dysfunction is associated with increased rate of pregnancy loss in India. Adverse fetal outcomes in subclinical hypothyroidism included spontaneous abortion (5.5 vs. 2.39 %) (Ajmani et al., 2014). Furthermore, Viegas et al. showed that the ethnicity of mothers, specifically Indian-born mothers, attracted a stillbirth rate at twice the rate observed in other foreign born women (Viegas et al., 1995).

2.22 Summary of the Scoping Review

The scoping review describes the adverse perinatal outcomes experienced by South Asian Indian-born mothers living inside and outside India. Adverse perinatal outcomes include low birth weight, pre-term birth, low Apgar score, and stillbirth (M. L. Davies-Tuck et al., 2017; Fuentes-Afflick & Hessol, 1997; Viegas et al., 1995).

2.23 Integrated Summary of Narrative & Scoping Reviews

Identification of the risk factors that predispose Indian-born mothers to increased adverse perinatal outcomes, is needed to better understand the factors involved. Universally agreed risk factors implicated in adverse perinatal outcomes have been described. However, many of these do not appear to apply to Indian-born mothers. This increased risk for adverse perinatal outcomes is not alleviated by access to internationally recognised quality maternity care provided in western countries such as Australia.

2.24 Gap Identified in the Literature

The evidence presented related to adverse perinatal outcomes for Indian-born mothers is broad and inconclusive. As a group, Indian-born mothers have been studied from an immigrant perspective, resulting in some confounding findings. Indian-born mothers immigrating to Australia tend to be from middle class families and well educated in contrast to other Australian immigrant groups. When studied as part of a wider immigrant group, the unique characteristics associated with Indian-born mothers are lost. Internationally recognised risk factors for adverse perinatal outcomes applied to immigrant groups do not appear to explain the increased risk experienced by Indian-

born mothers living and giving birth in Australia. Therefore, by comparing the perinatal outcomes of Indian-born mothers to other overseas-born mothers in Australia, this current study will contribute to addressing the gap in knowledge on this important issue.

The following research questions are addressed:

1. What identifiable socio-demographic risk factors, as they relate to obstetrics, are present prior to or during labour/delivery that can predict adverse perinatal outcomes among Indian-born mothers in Australia?
2. How do these outcomes compare to other overseas-born mothers in Australia?

There is a lack of recent, high quality literature reporting quantitative investigations about adverse perinatal outcomes for Indian-born mothers in Australia. The most recent literature was about stillbirth for Indian-born mothers in Australia (M. L. Davies-Tuck et al., 2017). As there is an increased number of Australian residents born in India, there is a need to further investigate the reasons for adverse perinatal outcomes for Indian-born mothers in Australia, and to construct measures to reduce this incidence.

2.25 Chapter Summary

This chapter examined the literature describing the risks for adverse perinatal outcomes among Indian-born mothers living inside and outside India. An updated search was conducted in 2018 that added studies published 2015–2018.

The conduct of the two reviews have demonstrated the existence of a gap in the literature relating to adverse perinatal outcomes for Indian-born mothers in Australia, and a paucity of studies reporting on adverse perinatal outcomes for Indian-born mothers internationally. This chapter concluded with the identification of this gap in the literature and apprised the research questions. The following chapter restates the research questions and presents a methodological approach to answering these questions. Table 3 presents the study characteristic of included studies, and Table 4 provides a summary of identified and reviewed articles in the scoping review.

Table 3: *Study Characteristic*

First author, year	Country	Research area	Ethnic populations	Sample size	Study design
M. L. Davies-Tuck et al. 2017	Australia	stillbirth	South Asian	n = 685, 869 singleton births n = 2299 stillbirths	Retrospective
Ajmani et al. 2014	India	Birth weight, Pre-term birth Stillbirth	Indian	n = 400 antenatal mothers	Randomized control trail (thematic analysis)
Jain et al. 2013	India	Birth weight, Pre-term birth	Indian	n = 645 pregnant mothers	Prospective cohort study
Koh et al. 2013	Singapore	Pre-term birth	Chinese, Malay or Indian	n = 1166	Comparative study
P. Gupta et al. 2012	India	Birth weight, Pre-term birth	Indian	n = 82 cases n = 164 controls	Case control study
Anuranga et al. 2012	Srilanka	Birth weight	Indian Tamil	n= 6374	Retrospective
Leon & Moser, 2012	UK	Birth weight, Pre-term birth	South Asian Indian	n = 861 654, babies	Cross sectional survey
Chakraborty & Anderson, 2011	India	Birth weight	Indian	n = 124,285	Retrospective
Patil et al. 2011	India	Birth weight, Pre-term birth	Indian	n **=** 342	Nested cohort study
Ashok Kumar et al. 2011	India	Birth weight, Pre-term birth	Indian	n = 893 women	Cross-sectional study
Meenakshi Titoria Sahu et al. 2010	India	Pre-term	Indian	n = 633, pregnant women in second trimester	Prospective study
Rowan et al. 2009	New Zealand	Pre-term	Indian (multiple ethnic group)	n = 212 infants	Retrospective cohort study
Pickett et al. 2009	UK	Birth weight, Pre-term birth	Indian (multiple ethnic group)	n = 18,819 infants n = 18,533 their families	Cross-sectional analysis study
Basu et al. 2008	India	Birth weight, Pre-term birth	Indian	n = 260 VLBW newborns	Retrospective cohort
Hayes et al. 2008	USA	Birth weight	Asian Indian (multiple ethnic group)	n = 293 211births	Retrospective cohort

Continued…

Table 3 *Continues*

First author, year	Country	Research area	Ethnic populations	Sample size	Study design
Agnihotri et al. 2008	India	Birth weight	Indian	n = 894 parents (n = 472 fathers n = 422 mothers n = 1525 children)	Qualitative (Intergenerational study involving two birth cohorts)
Alexander et al. 2007	USA	Birth weight	Asian Indian American (multiple ethnic group)	n = 4,975,449 births	Retrospective cohort
Madan et al. 2006	USA	Birth weight	Asian Indian mother (multiple ethnic group)	n = 9.1 million singleton U.S. births	Retrospective cohort
V. Patel & Prince, 2006	UK	Birth weight	Indian	n = 270 mothers	Qualitative studyinterview
A. K. Rao, Cheng, et al. 2006	USA	Birth weight, Pre-term birth	Asian Indian (multiple ethnic group)	n = 3779 mothers	Retrospective study
Gould et al. 2003	USA	Birth weight, Pre-term birth	Asian Indian (multiple ethnic group)	n = 1 622 324 births	Retrospective cohort
A. Sen et al. 2005	India	Birth weight, Pre-term birth	Indian	n = 319	Qualitative randomized controlled trial
P. C. Gupta & Sreevidya, 2004	India	Birth weight, Pre-term birth	Indian	n = 1217 mothers	Qualitative
Kinare et al. 2000	India	Birth weight	Indian	n = 2675 mothers	Qualitative / prospective community-based study
Viegas et al. 1995	Singapore	Birth weight, Pre-term birth, stillbirth	Chinese, Malay and Indian mothers	n = 26,173 births	Retrospective cohort
Fuentes-Afflick & Hessol, 1997	USA	Birth weight	Asian Indian (multiple ethnic group)	n = 271,960 births	Retrospective cohort

Table 4: ***Summary of Identified and Reviewed Articles***

Author, Year	Intervention	Methods/sample	Critique of the study
M. L. Davies-Tuck et al. 2017	All singleton births at 24 or more weeks gestational age from 2000–2011 in a routinely reported on stillbirths due to termination of pregnancy, babies with congenital anomalies of all births in Victoria, Australia	Quantitative / descriptive / Retrospective comparative cohort study / 685,869 singleton births and 2299 stillbirths	This study give information to only stillbirth as perinatal outcomes among mothers born in India. However, failed to give information about mother ethnicity which was not reported to the Victorian Perinatal Data Collection (VPDC).
Ajmani et al. 2014	Pregnant women between 13 and 26 weeks of gestation were tested TSH tests, Free T4 and anti-TPO antibody and Patients were followed up, till delivery	Randomized control trail / 400 pregnant women	Small sample size. Thyroid dysfunction is not common and not routine screening test during pregnancy.
Jain et al. 2013	Pregnant women until 20 wk and between 32 to 34 wk gestations were tested their mid-stream urine sample for culture and sensitivity. Women having $>10^5$ colony forming positive for Asymptomatic bacteriuria were diagnosed and treated.	Prospective comparative cohort study / 645 pregnant mothers	This research has a potential to adverse perinatal outcomes. But Asymptomatic bacteriuria is common only among population with poor personal hygiene and in poor environmental sanitation.
Koh et al. 2013	Mothers delivered a live singleton infants whose bodyweight during the pre-pregnancy period or within 2 weeks of delivery or at both times, were calculated for gestational weigh gain.	Comparative study / 1166 Chinese, Malay, and Indian women	The study failed to explain specifically that gestational weight gain are associated with adverse perinatal outcomes.
P. Gupta et al. 2012	The data was collected on maternal and newborn characteristics among cases and controls. Perinatal outcomes were compared between assisted reproductive techniques (ART) conceived and spontaneously pregnant women in terms of birth weight, preterm, multiple pregnancies, and neonatal complications.	Comparative cohort study / 82 cases and 164 controls pregnant women	Small sample size. Not clearly explained the risk for adverse perinatal outcomes.

Continued…

Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
Anuranga et al. 2012	The data from DHS surveys of the Department of Census and Statistics with Birth Weight information between 1993, 2000 and 2006-07 were investigated the trends, inequalities and determinants of low birth weight (LBW) in Sri Lanka.	Comparative study/ Ever-married, 15-49 years old women and their children	This study focus only poor and Tamil speaking Indian.
Leon & Moser, 2012	A unique linkage of routine records for the whole of England and Wales to estimate mean birth weights of the live singleton birth in the UK between 2005 & 2006 of Bangladeshi, Indian, Pakistani or White British ethnicity origin where the mother was born in England & Wales or in the Indian sub-continent.	Cross sectional review of birth notification data linked to national ONS data / 861,654, all babies born in England, Wales and the Isle of Man	This study combined South Asian mothers group as a whole for analyses not by country (Indian-born mothers specially).
Chakraborty & Anderson, 2011	Secondary data analysis, examined data from the 2005–2006 National Health and Family Survey (NFHS 3) of India to compare the regional prevalence of low birth weight babies.	Descriptive study / 124,285 women in the reproductive age group (15–49 years) from the states of India	This study is correspondence only to poor, low socioeconomic women in India (low maternal autonomy) as an indicator of low birth weight.
Patil et al. 2011	Birth outcomes of 212 HIV-infected pregnant women were compared with those of 130 HIV-uninfected pregnant women attending a government tertiary care hospital between 2002 and 2004. Birth outcomes and maternal morbidity data were collected at delivery.	Nested cohort study / 342, HIV-infected women enrolled in Six Weeks Extended-Dose Nevirapine	Small sample size. The study not clearly explained the antenatal care during HIV exposure.

Continued…

Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
Ashok Kumar et al. 2011	To detect difference between cases and the control group the presence of antigliadin IgA and IgG, anti-tissue transglutaminase IgA by ELISA, and IgA antiendomysium antibody by indirect immunofluorescence microscopy.	Cross-sectional hospital-based study / 893 women	This study reported risk factors unexplained infertility, recurrent abortions, stillbirths, or IUGR could be subclinical celiac disease and this only for poor reproductive outcome population in India.
Meenakshi Titoria Sahu et al. 2010	Serum sample were collected and TSH level estimation was done. If TSH level was deranged then free T4 and thyroperoxidase antibody level estimation were done over a period of 3 years from May 2005 to April 2008. Patients were managed accordingly and followed till delivery. Their obstetrical and perinatal outcomes were noted.	Prospective study / 633 pregnant women in second trimester were registered	This study not estimated all the possible TSH level; i.e. Between maternal and cord blood. Small sample size in comparison with infrequency of disease.
Rowan et al. 2009	Data from a previous retrospective cohort study of women with type 2 diabetes who delivered between 1998 and 2003 were used to compare neonatal outcomes between small for gestation age infants. From the original cohort a set of twins and a miscarriage at 19 weeks gestation were excluded, leaving 212 singleton pregnancies in women with type 2 diabetes available for analysis.	Retrospective cohort study / 212 pregnant women with type 2 diabetes.	Small sample size. This study not clearly explained the cause for small for gestation age.
Pickett et al. 2009	Data are from the Millennium Cohort Study (MCS), during 2000–2002 in the United Kingdom investigated the effects of area-level same ethnic density on maternal and infant health, independent of area deprivation and individual socioeconomic status, in five ethnic minority groups. Outcome measures included: low birth weight, preterm delivery, maternal depression, self-rated health and limiting long-standing illness.	Cross-sectional analysis / (Black African n = 367, Bangladeshi n = 369, Black Caribbean n = 252, Indian n = 462 and Pakistani n = 868) and their 9-month old infants.	This study not explained the ethnic density as a protective measure for maternal and child health among minority ethnic groups in UK.

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Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
Basu et al. 2008	The medical records of VLBW neonates admitted over three years were studied with the help of medical records section	Retrospective cohort study / 260 VLBW newborns	This study not supported with evident related to treatment of maternal bleeding which is anticipated as predictors of infant mortality.
Hayes et al. 2008	Data from the 1998–2003 birth certificate data used in this analysis of descriptive maternal characteristics, birthweight distributions, mean birthweights, and measures of low birthweight were ascertained by maternal race and nativity status within each race subgroup.	Retrospective cohort study / 293,211 births	This study conveyed the importance of determination of the impact of heterogeneity and differences related to maternal nativity while measuring health outcomes for the Asian population.
Agnihotri et al. 2008	Determination of the correlation between parental and offspring birthweight using parental measurements, anthropometry at birth, and longitudinal growth assessment till adolescence recorded in their homes by trained health workers in India.	Intergenerational study / two birth cohorts of successive generations 894 parents - (472 fathers and 422 mothers) 1525 children	This study reported maternal birth weight as a significant predictor of offspring birth weight. Also stated genetic factors had little influence on birth weight. Small study sample.
Alexander et al. 2007	Analysis entailed an initial examination of race/ethnic group variations as either Asian-Indian, non-Hispanic White, or non-Hispanic African-American (Black), in maternal risk factors, prenatal care utilization and adverse birth outcomes dawned from the NCHS 1995 to 2000 U.S. Linked Live Birth/Infant Death files	Retrospective cohort study / 4,975,449 Single live births to U.S. resident mothers	This study reported that ethnicity may be related to low birth weight. Whereas, low birth weight related to certain genetic factors such as mother undernourished during childhood.
Madan et al. 2006	U.S. National vital records for births during 1995–2000 were analysed to examine the incidence rates of perinatal complications such as low birth weight and small for gestational age infants in comparison between complications and outcomes were compared between the U.S- and foreign-born women in both ethnic groups.	Comparative study / 9.1 million singleton U.S. births	This research has a potential to my current study reported Asian Indian-born mothers have twice increased risk for low birth weight in the next generation compared to others in U.S.

Continued…

Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
Patel & Prince 2006	Interviewed women attending the hospital's antenatal clinic who were more than 30 weeks pregnant with a screening12-item questionnaire for psychological morbidity. Babies of 250 mothers were reviewed at birth to measure their weight categorised as quartiles of GHQ scores, and low birth weight in term babies; premature babies (<37 weeks).	Qualitative study / interview / 270 Pregnant mother at 34 weeks	Small sample size. Stated risk factor for low birth weight is not supported with evidence.
A.K.Rao, Cheng et al. 2006	Deliveries to Asian American/Pacific Islander (AAPI) women who met the study criteria during1998 to 2003; perinatal outcomes between Asian American and Pacific Islander subgroups was examined. Demographic data and information regarding perinatal and neonatal outcomes were obtained from the Stanford Perinatal Database.	Retrospective cohort study / 3779 Asian American/Pacific Islander women	This study explained only the ethnicity of the mother and not paternal. Also not stated mothers place of birth. Explained increased risk for perinatal outcomes such as low birth weight and gestational diabetes mellitus in South Asian Indian American population.
Gould et al. 2003	California linked infant birth/death certificate files for Self-reported race and ethnicity were determined from the birth certificate during 1995–1997 were extracted. Sociodemographic risk profiles; the percentage of LBW, very low birth weight (VLBW), prematurity, and intrauterine growth retardation (less than third percentile); and percentage of fetal, neonatal, and post neonatal were compared death rates were compared.	Retrospective cohort study / 1,622,324 births	This study correlates to the current study stating that low risk socioeconomic status Asian Indian-born mothers have increased neonatal death and intrauterine growth restriction.

Continued…

Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
A.Sen et al. 2005	Evaluation of routine antimicrobial therapy during the second trimester of pregnancy on birth-weight and gestation in urban poor pregnant women in the metropolitan city of Kolkata, India. Detailed history, anthropometric measurements, and clinical examinations of the subjects were recorded in a pre-tested data form. Urine was tested by the dipstick method and infection indicators protein, nitrites, and leucocytes were recorded.	Qualitative randomized controlled trial / 224 pregnant women in their second trimester	This study not clearly explained the antimicrobials effect in pregnancy and related pregnancy outcomes.
P.C.Gupta & Sreevidya, 2004	Information gathered on demographics, tobacco use, and medical and obstetric histories from the women in Mumbai. They used bathroom scales and a tape measure to obtain their weight and height. Included all women who had used a smokeless tobacco product at least once a day for the past six months. Also categorised the frequency of use as light (one to four times per day) or heavy (five or more times per day). Interviews took place on delivery, and birth weight and date of delivery were copied from the infant's immunisation card.	Prospective cohort study, Population based / interview / 1,217 women who were three to seven months pregnant and planning to deliver in the study area	This study reported that smokeless tobacco among Indian mothers in India have increased risk of low birth weight.
Kinare et al. 2000	A prospective community-based study of maternal nutrition and fetal growth in 6 villages, Pune. Mid - pregnancy placental volume determined by means of ultrasonography at 15 to 18 weeks' gestation, maternal anthropometric measurements before and during pregnancy, and maternal blood pressure and biochemical parameters during pregnancy were measured. Neonatal size and placental weight were measured at birth.	Prospective community-based study / 2,675 eligible women (married, aged 15-40 years, and unsterilized) were listed by a house-to-house survey.	This study not clearly explained that, small mid pregnancy placental volume is the cause of low birth weight in Indian babies.

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Table 4 *Continues*

Author, Year	Intervention	Methods/sample	Critique of the study
Viegas et al. 1995	Perinatal mortality was analysed in the three ethnic groups seeking maternity care at the National University Hospital over a 7-year period from January 1986 to December 1992. The influence of ethnicity on obstetric performance in Singapore was analysed.	Retrospective study / 50,044 Asian and 221,866 white women who delivered singleton live births	This study not clearly explained the cause of perinatal outcomes for Indian-born mothers. Reported that poor nutritional status among Indian-born mothers may be the influence of low birth weight.
Fuentes-Afflick & Hessol, 1997	Investigated the relationship between Asian ethnicity/national origin and low birth weight (<2,500 grams) from the 1992 California birth certificate database. Ethnic and subgroup differences in prenatal characteristics and birth weight outcomes were analysed.	Comparative study/ 271,960 single live births	This study stating mostly perinatal outcomes among Asians as a whole. Specific Indian-born mothers perinatal outcomes were less stated.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter describes the methodological approach of the current study. A retrospective cohort study design was utilised to investigate the adverse perinatal outcomes for Indian-born mothers in Australia. As already stated, the research questions are:

1. What identifiable socio-demographic risk factors, as they relate to obstetrics, are present prior to or during labour/delivery that can predict adverse perinatal outcomes among Indian-born mothers in Australia?
2. How do these outcomes compare to other overseas-born mothers in Australia?

The objective of the current study is, therefore, to identify the risk for adverse perinatal outcomes of Indian-born mothers as compared to other mothers living and giving birth in Australia. This chapter discusses the methodological approach to analysing the data, and reports on the research design using secondary data, ethical consideration, data sources, setting, population, and data analysis.

3.2 Research Design

A retrospective cohort study was utilised that was quantitative, descriptive, correlational, and non-experimental in its approach. The researcher examined the

quantitative association of variables from Indian-born mothers and compared them with other mothers giving birth in Australia.

3.3 Using Secondary Data

Secondary data is data which has previously been collected for a purpose not relating to the current research. This data can be used to answer questions unrelated to the original purpose (Boslaugh, 2007; Cheng & Phillips, 2014; Doolan & Froelicher, 2009). Current advances in health information technology can facilitate the collection and archiving of information at an extraordinary rate: a new frontier for health research opportunities (Coorevits et al., 2013). With the potential to gather new information and knowledge from large and convenient data sources, such as electronic health records, new areas for clinical research can be identified (Coorevits et al., 2013; Jensen, Jensen, & Brunak, 2012). As electronic health records capture and integrate information on all aspects of birth outcomes over a specified time period, they can contribute to the future provision of health care (Jensen et al., 2012). Although originally the data was collected for another purpose, existing databases can be reconstructed, using a variety of retrospective research designs to answer a range of research questions (Knottnerus & Tugwell, 2011). Standardised collection of data has the potential to allow comparisons over time, providing unique approaches to health issues that have not been previously possible (Coorevits et al., 2013; Mann, 2003).

The advantages of secondary data lie in time and cost savings (Knottnerus & Tugwell, 2011; T. Magee, Lee, Giuliano, & Munro, 2006; Mann, 2003). However, secondary data will not provide all the answers for new research questions. As the data was

intended to be collected for other purposes, data sets used in this research should be compatible with the research questions (T. Magee et al., 2006). Ideally, data sets should be chosen that have existing variables that closely align with the proposed study. To enable analysis, it is possible some of the retained data may require cleaning, editing, or recoding to create new variables (Van den Broeck, Cunningham, Eeckels, & Herbst, 2005).

Similarly, using pre-existing databases can be an innovative method for undertaking research. However, there are ethical and methodological risks that must be considered prior to the commencement of research. The increasing implementation of electronic information systems has created increased research opportunities (Coorevits et al., 2013). Although there is no direct contact with participants, any research using secondary data requires approval from an appropriate ethics committee (Coyer & Gallo, 2005). As consent for the research cannot be obtained retrospectively, all information should be de-identified, with aggregate findings reported as much as possible (Coorevits et al., 2013). The researcher should also be aware of the limitations for the internal and external validity of the new study. Such issues were considered for the current study, with the approach taken outlined in Section 3.4 of this chapter. The advantage of using pre-existing databases is that research bias is reduced as a result of both the increased amount of data and the independence of that data from the researcher, thus strengthening the internal validity of data sets (Mann, 2003).

3.4 Ethics Approval

Ethical approval for the analysis of this current study was obtained from Monash University Human Research Ethics Committee (MUHREC) (Appendix 1), and from Monash Health Human Research Ethics Committee (MHHREC) (Appendix 2). Given the size of the population-level data set held by the AIHW National Perinatal Data Collection (i.e.: 312,153 births in 2012), and by the Monash Health (BOS) database (i.e.: 3,175 births in 2014), it would have been impossible to obtain informed consent from everyone whose records have been used. Because of this, identifying variables such as name and addresses were not supplied in order for anonymity of individuals to be protected.

The National Perinatal Data set for 2012 was obtained in aggregated form and a non-aggregated data set was obtained from Monash Health for 2014. Ethical approval for the current study was obtained in May 2016 for NPD, and in February 2017 for Monash Health (BOS) Data.

3.5 Quantitative Methodology Approach

A quantitative methodology was applied to this study, as this approach focuses on the objective measurement of data across a large number of people (Babbie, 2010; Edmonds & Kennedy, 2012; Muijs, 2010). A quantitative descriptive research approach can determine the association among variables (Muijs, 2010). Also, a quantitative design facilitates a common understanding of the research problem by carefully designing a method for answering the research questions, guiding the

approach to data collection, and informing the approach to data analysis (Creswell & Creswell, 2017).

This study used pre-existing government data obtained at the national and the Victorian State level. A quantitative, descriptive, correlational approach allows the researcher to explore the association among three different groups (Indian-born, Australian-born, and Other overseas-born mothers). This approach gives a clear understanding of the adverse perinatal outcomes by examining the association of risk and non-risk factors regarding adverse perinatal outcomes in Australia during one calendar year. Moreover, the design used was considered to be the appropriate method for analysing data within both data sets, as well as calculating the effect sizes for each variable (Pallant, 2013).

3.6 Data Sources

The current study examined two large perinatal data sets. Firstly, the National Perinatal Data Set (NPD) from the Australian Institute of Health and Welfare (AIHW) National Perinatal and Epidemiology Statistics Unit (NPESU) provided one calendar year of data from 1 January to 31 December 2012. The data requested from the NPD included demographic data (except name and home address).

The data analysed in the current study were extracted by the AIHW (NPESU), which undertakes national reporting of reproductive and perinatal health information and statistics in Australia. The data collected were obtained from the University of New South Wales Information Matrix (MIM), 2011-2014 (Australian Institute of Health and

Welfare and University of New South Wales, 2011). The AIHW (NPESU) provides national epidemiological health services, and conducts policy and health economic research in reproductive, perinatal, and maternal health. The priority areas of research include: maternal and perinatal morbidity and mortality, assisted reproductive technologies (ART) (Y. A. Wang, Chambers, & Sullivan, 2010), Aboriginal Health, psychosocial health, and mothers in custody (National Perinatal Epidemiology and Statistics Unit, 2018a). The National Perinatal and Epidemiology Statistics Unit (NPESU) carries out its functions by working with an extensive range of collaborators, including the Australian Institute of Health and Welfare, State and Territory Health Departments, the Royal Australian and New Zealand College of Obstetricians and Gynaecologists, the Australian College of Midwives, the Society of Obstetric Medicine Australia and New Zealand, Fertility Society of Australia, Australia and New Zealand Neonatal Network, maternity hospitals and fertility clinics, and international organisations such as the New Zealand Perinatal and Maternal Morbidity Review Commitee (National Perinatal Epidemiology and Statistics Unit, 2018a; Wyld, Clayton, Jesudason, Chadban, & Alexander, 2013).

The National Perinatal and Epidemiology Statistics Unit (NPESU) manages a number of national data collections including the AIHW National Perinatal Data Collection, AIHW Australian Congenital Anomalies Monitoring System, Australasian Maternity Outcomes Surveillance System, Australian and New Zealand Neonatal Network (ANZNN) and Australian and New Zealand Assisted Reproductive Database (ANZARD) (Wyld et al., 2013). It provides linkages to an array of information from different sources such as information on pregnancy, parturient, and neonatal health. Because of the breadth of this information, the National Perinatal and Epidemiology

Statistics Unit (NPESU) has been used in epidemiological research, and has provided a solid evidence base for shaping pregnancy health statistics in Australia, (Wyld et al., 2013; Yeo et al., 2015).

The National Perinatal Data (NPD) is a national, population-based, cross-section data collection focussing on pregnancy and childbirth. Information is included in the NPD for all live births and stillbirths of at least 400 grams birthweight or at least 20 weeks gestation (Hilder, Zhichao, et al., 2014). The data collected is based on births reported to the perinatal data collection in each state and territory in Australia (AIHW, 2018). The maternal information data collected is used to track progress against national and international indicators, and for routine reporting, service planning, performance monitoring, quality and safety reviews (including death classifications and sentinel events), epidemiological studies and other research, and to report on Aboriginal and Torres Strait Islander health and births (J Walker, 2011).

The Maternity Information Matrix (MIM) was commenced in 2010. It is a web-based summary of data items in Australian jurisdictional and national data collections relevant to maternal and perinatal health (J Walker, 2011). The matrix is an electronic inventory (available as a Microsoft Excel file) organized by topic to correspond with each stage in the maternity pathway, with data items grouped into subject areas and subtopics. A data collection overview was modelled on the Australian Bureau of Statistics Data Quality Statement (DQS) in order to summarize information about institutional environment, relevance, timeliness, accuracy, accessibility, coherence and interpretability (Hilder, Li, Zeki, & Sullivan, 2014).

The Maternity Information Matrix web version was developed and updated in August 2011, based on data collection practices as at July 2011 of the National Maternity Data Development Project (NMDDP), with updated changes completed in February 2012 (National Perinatal Epidemiology and Statistics Unit (2018b). The MIM is used as the baseline for analysis of information needs and gaps as part of scoping information needs and gaps in National data in the National Maternity Data Development Project (NMDDP).

The MIM includes 45 vastly different data collections (Australian Institute of Health and Welfare and University of New South Wales, 2011), containing records on hospital morbidity systems, perinatal data collections, perinatal and maternal deaths, and congenital abnormalities. Specialist information collections include hospital records (midwives, doctors, other clinicians, administration); vital registries (such as the Australian Bureau of Statistics (ABS)) – Coroner reports; and State/Territory health department files. These specialist information collections are administered by bodies such as the National Perinatal Epidemiology and Statistics Unit (NPESU), the Australian Institute of Health and Welfare (AIHW), the Australian & New Zealand Neonatal Network (ANZNN), the Australian Congenital Anomalies Monitoring System (ACAMS), the Perinatal National Millennium Data Set (NMDS), the Australasian Maternity Outcomes Surveillance System (AMOSS), and the National Hospital Morbidity Database (NHMD) (Figure 4). Data is collected on an ongoing basis, with the latest full year of data available being for the 2012 calendar year (J Walker, 2011). Thus, the MIM is a snapshot of maternal information in Australia.

As the national data was obtained in aggregated form, and did not provide information relating to maternal medical conditions, past history, birth defects, neonatal morbidity, or obstetric complications, this current study utilised non-aggregated data solely from Monash Health (BOS) for 2014.

The second data set came from Monash Health. The Monash Health Birthing Outcomes System (BOS) data set for the year 2014 was obtained as non-aggregated data from Monash Health, which is a part of the Victorian State Perinatal Collection (VPDC). VPDC is a population-based surveillance system that collects information on the health of mothers and each birth in Victoria. It also contains information on obstetric conditions, procedures and outcomes, neonatal morbidity and congenital anomalies relating to every birth in Victoria (Flood, McDonald, Pollock, & Davey, 2017; Victorian Government, 2018). The VPDC is part of National Perinatal Data Collection. The VPDC are sent to the National Perinatal Statistics Unit for the production of an annual report on Australia's mothers and babies (Victorian Government, 2018). Data regarding mothers' socio-demographical details, maternal country of birth, health conditions before and during pregnancy, complications during labour and delivery, and perinatal outcomes, such as maternal and newborn health status after birth are collected (Hilder, Zhichao, et al., 2014). Perinatal outcome data collected includes preterm delivery, birth weight, stillbirths, Apgar scores, congenital anomalies and neonatal deaths (Hilder, Zhichao, et al., 2014).

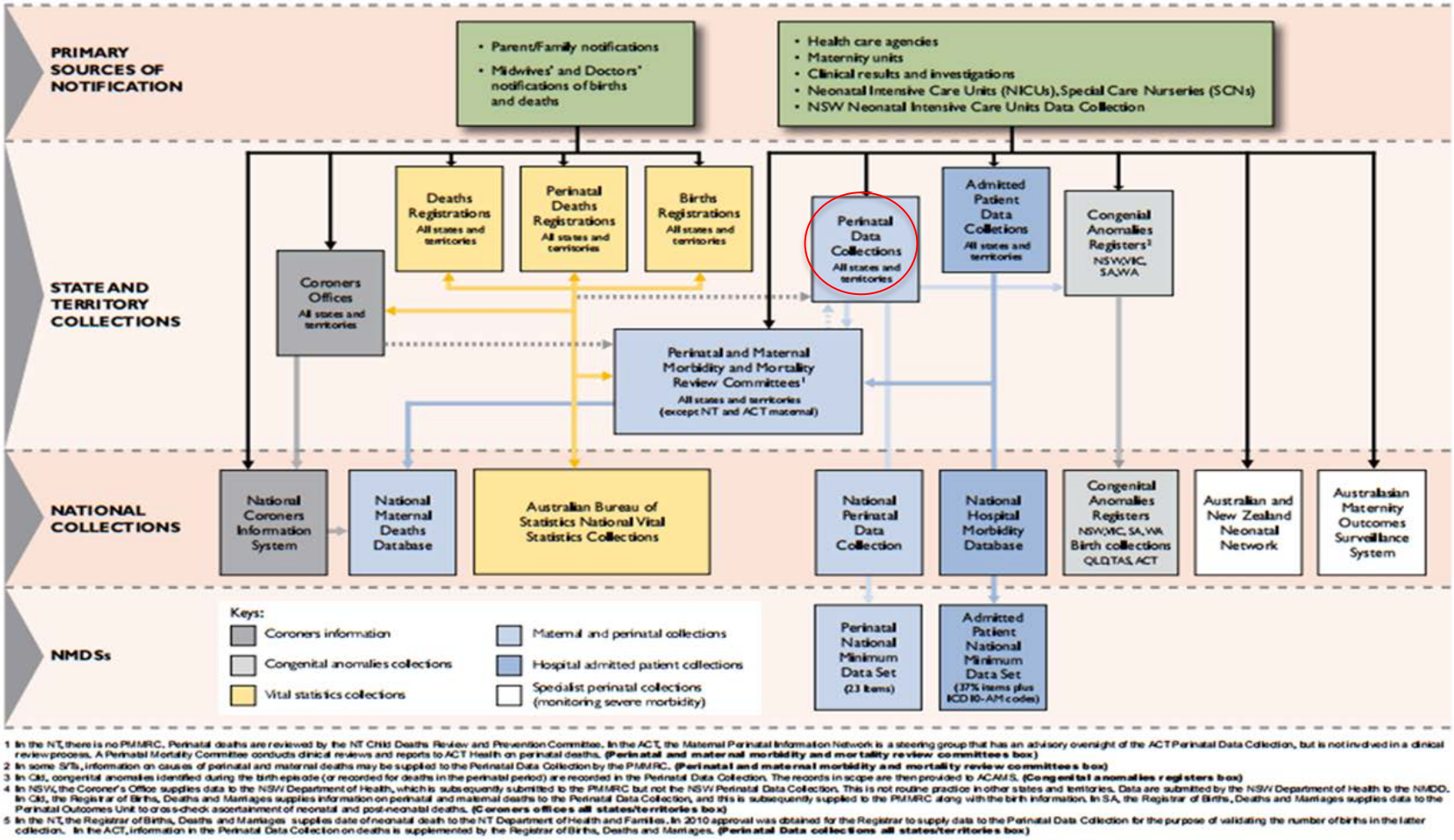
Monash Health is Victoria's largest public health service provider and the largest maternity provider; providing maternity care to one quarter of Melbourne's population

across three hospitals (Gibson-Helm et al., 2014). The Birthing Outcomes System (BOS) is an electronic data set of all births at Monash hospitals. BOS data is routinely entered during the first pregnancy visit and, subsequently, at birth by midwifery staff. The data is routinely maintened, cleaned and validated (Gibson-Helm et al., 2014).

As mentioned, the Monash Health data set contains non-aggregated data regarding each of the variables, enabling more sophisticated inferential statistical analysis to be calculated. The two data sets contain essential information relating to the incidence of adverse perinatal outcomes for all mothers giving birth in Australia in 2012, and at Monash Health in 2014. All the variables available in these data sets are listed in Appendix 3. Also, a description of the variables in both data sets are contained in Appendix 4. From these data sets, it was possible to extract information relating to the incidence of adverse birth outcomes for Indian-born mothers, and to compare these outcomes with other mothers living and giving birth in Australia in 2012 and at Monash Health hospitals in 2014.

This current study examined if sociodemographic factors such as mother's age and ethnicity were predictive and, thus, explicative in regards to adverse perinatal outcomes. Differences in maternal medical risk factors, such as diabetes, hypertension, and substance abuse, were also examined.

***Figure 4*: The Relationship between State and National Perinatal Data Collection**



1 In the NT, there is no PMMRC. Perinatal deaths are reviewed by the NT Child Deaths Review and Prevention Committee. In the ACT, the Maternal Perinatal Information Network is a steering group that has an advisory oversight of the ACT Perinatal Data Collection, but is not involved in a clinical review process. A Perinatal Mortality Committee conducts clinical reviews and reports to ACT Health on perinatal deaths. **(Perinatal and maternal morbidity and mortality review committees box)**
2 In some S/Ts, information on causes of perinatal and maternal deaths may be supplied to the Perinatal Data Collection by the PMMRC. **(Perinatal and maternal morbidity and mortality review committees box)**
3 In Qld, congenital anomalies identified during the birth episode (or recorded for deaths in the perinatal period) are recorded in the Perinatal Data Collection. The records in scope are then provided to ACAMS. **(Congenital anomalies registers box)**
4 In NSW, the Coroner's Office supplies data to the NSW Department of Health, which is subsequently submitted to the PMMRC but not the NSW Perinatal Data Collection. This is not routine practice in other states and territories. Data are submitted by the NSW Department of Health to the NMDD. In Qld, the Registrar of Births, Deaths and Marriages supplies information on perinatal and maternal deaths to the Perinatal Data Collection, and this is subsequently supplied to the PMMRC along with the birth information. In SA, the Registrar of Births, Deaths and Marriages supplies data to the Perinatal Outcomes Unit to cross-check ascertainment of neonatal and post-neonatal deaths. **(Coroners offices all states/territories box)**
5 In the NT, the Registrar of Births, Deaths and Marriages supplies date of neonatal death to the NT Department of Health and Families. In 2010 approval was obtained for the Registrar to supply data to the Perinatal Data Collection for the purpose of validating the number of births in the latter collection. In the ACT, information in the Perinatal Data Collection on deaths is supplemented by the Registrar of Births, Deaths and Marriages. **(Perinatal Data collections all states/territories box)**

Source: AIHW: Walker, J. (2011). Maternity data in Australia: a review of sources and gaps. Bulletin no. 87. Cat. no. AUS 136. Canberra: AIHW. p 7

3.7 Limitations of the Data Sets Used

Analysing the National Perinatal Data (NPD) data provides a unique insight into perinatal outcomes among Indian-born, Australian-born, and other mothers across Australia in the year 2012. This insight is supplemented by data for the State of Victoria in 2014, specifically the Monash Health (BOS) data set for 2014. However, there are limitations in using data collected for other purposes. These limitations include issues with aggregation and availability of data, and lack of comparitive previous reseach studies on the topic.

Additionally, data, as expressed by the field ‘not stated’, is often incomplete as a result of unsystematic documentation. This current study was performed in the whole Australian context, so generalisability was limited. However, performing analysis on population data within this context strengthened the external validity.

3.8 Setting

This study was conducted in Australia. Australia is an island continent and the world's sixth largest country with a landmass of 7,682,300 square kilometers (Australian Government, 2015). The total population of Australia is, as of December 2014, roughly 23.6 million people (Australian Government, 2015). The Victorian population in 2014 was 5,841,700 (ABS, 2014).The total number of births in 2012 in Australia was 312,153 (Hilder, Zhichao, et al., 2014).

3.9 Population

The study population comprised all mothers giving birth to babies in Australia from January to December 2012, and at Monash Health in the state of Victoria in 2014. In 2012, of “the 312,153 national births in 2012, of which 2,255 were stillbirths, the average maternal age was 30 years, with the youngest 15 years and the eldest 56 years”. Of, women who gave birth in Australia in 2012, 31.2% were born in countries other than Australia. Regarding parity, 42.4% of mothers had their first baby and 33.2% had their second baby. In 2012, 62.7% of women attended at least 1 antenatal visit in the first trimester (before 14 weeks gestation), and 14.9% did not begin antenatal care until after 20 weeks gestation. Hospitals are the place of birth for almost all mothers (96.9%). Of all the women who gave birth, 19.4% had a caesarean section without labour and 12.9% had a caesarean section with labour. Of women who gave birth in hospitals in 2012, the proportion in private hospitals was 29.0%. Also, 6.2% of live born babies were of low birthweight (less than 2,500 grams). In addition, 1.7% of live born babies had a low Apgar score (between 0 and 6) at 5 minutes (refer Appendix 6).

In 2014, the number of mothers who delivered at Monash Health was 3,172. Of these births, 3 were stillbirths. The average maternal age was 30 years, with the youngest at 15 years and the eldest at 56 years. Of women who gave birth at Monash Health in 2014, 61.8% were born in countries other than Australia. Regarding parity, 32.5% of mothers had their first baby and 13.1% had their second baby. In 2014, 19.3% of babies were admitted to special care nurseries, and 2.0% were admitted to neonatal intensive care units. Of all the women who gave birth,15.2% had a emergency caesarean section and 14.4% had a elective caesarean section. Of women who gave

birth in Monash Health in 2014, the proportion of mothers who smoked during pregnancy was 10.1%. Also, 3.4% of live born babies were of low birthweight (less than 2,500 grams). In addition, 1.6% of live born babies had a low Apgar score (between 0 and 6) at 5 minutes (refer Appendix 7).

3.10 Data Linkage

Data linkage is used when essential information is not available in a single dataset. Data linkage is a collection of records from different sources describing the same population or event (Holman et al., 2008). The National Perinatal Data is a routinely collected ongoing perinatal data set, and includes all births in Australia. Due to the costs of obtaining all of the data for 2012, the researcher was only able to access the aggregated National Perinatal Data for 2012. This data did not contain information relating to maternal medical conditions, past history, neonatal morbidity, birth defects, and admission to Special Care Nurseries (SCN) or Neonatal Intensive Care Units (NICU).

Non-aggregated, unit level, Monash Health (BOS) Data 2014 was also obtained, as this is one of the largest perinatal data sets in the State of Victoria. This data relates to all births at Monash Health hospitals in 2014. This non-aggregated Monash Health (BOS) data was used to examine the adverse perinatal outcomes for all mothers, including maternal medical conditions, birth defects, past history, obstetric complications, and neonatal morbidity.

3.11 Challenges with the Data Classification

Both data sets provide a broad, clinical profile of the mother during pregnancy and delivery. To aid desired statistical outcomes, recoding and merging of variables was undertaken (Appendix 7 & 8). For example, mothers were grouped as 1=Indian-born, 2=Australian-born, 3=other overseas-born.

To ensure thoroughness, the process of recoding all variables was enacted prior to a final decision regarding the categorisation of each variable (e.g. mothers' country of birth, maternal age, Apgar score, etc.). Furthermore, data recoding was enacted in an environment of inconsistent aggregation; as mentioned, the National Perinatal Data (NPD) did not provide information of birth defects, neonatal morbidity, obstetric complications or past medical history. On the other hand, Monash Health (BOS) data provided maternal obstetric and gynaecologic information. Usually these variables are assigned to the mothers, however the Monash Health (BOS) Data assigned these variables to the baby (refer Appendix 3 & 4).

3.12 Data Entry

The data sets obtained from the National Perinatal Data Set (NPD) and from Monash Health (BOS) were provided to the researcher in the form of Excel spreadsheets. The two data sets consisted of 25 variables in total per mother (Appendix 4). The data sets from the Excel spreadsheets were imported into the statical analysis program, Statistical Package for the Social Sciences (SPSS), version 23 for Windows (International Business Machines Corporation, 2015). Each data set was recoded before data analysis, and the codes for each variable were duplicated for each data

set (e.g. Indian-born mother is coded as 1, Australian-born mother as 2, other overseas-born mother as 3). Prior to this, as mentioned above, individual variables in the data sets had been examined for relevance to the study (Appendix 3), and then recoded (Appendix 8 & Appendix 9).

3.13 Grouping Variables

After the selection and recoding of the variables from the data sets, each variable was grouped. For example, the variable 'maternal age' was set from 14 to >40 years in the data sets. The researcher grouped age as <20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, ≥40 years. The same process was enacted for the remaining 24 variables (Appendix 4).

3.14 Study Variables

The two data sets used in the current study involved all mothers giving birth in Australia in 2012, and in Victoria via Monash Health (BOS) in 2014. As indicated above, this equated to approximately 312,153 births nationally in 2012, and 3,175 births at Monash Health in 2014. In the current study, the independent and dependent variables that were used in the analyses performed are contained in Table 5 below. Other variables were also used in the analyses performed, with the confounding impact and effects of these variables on adverse perinatal outcomes being examined. The issue of the receipt of regular antenatal care is an example of the variables considered in this way.

Table 5. ***Dependent and Independent Variables***

Independent Variables	Dependent Variables
Maternal age	Birth status
SEIFA IRSD	Preterm delivery
Parity	Birth weight
Maternal country of birth	Stillbirths
Plurality	Neonatal death
Maternal marital status	Apgar score
Past history	Admission to special care nurseries or neonatal intensive care units
Substance abuse	Neonatal morbidity
Maternal BMI (kg/m^2)	Birth defect
Maternal medical conditions	Obstetric complications

In the data sets, there was no information about the population who were of Indian descent but born in Australia. Consequently, it was not possible to disaggregate outcomes of Indian mothers born in India with women of Indian descent born in Australia or other overseas countries in both data sets. Thus the differences between mothers who are Indian-born were examined and compared to mothers that were born in other overseas countries, namely other overseas-born mothers, and mothers born in Australia namely, Australian-born mothers, both latter groups also potentially containing mothers with an Indian background. Ackowledging this ethnic limitation, these three groups were used to affect comparisons. The following Figure 5 illustrates the proposed conceptual approach to analysis.

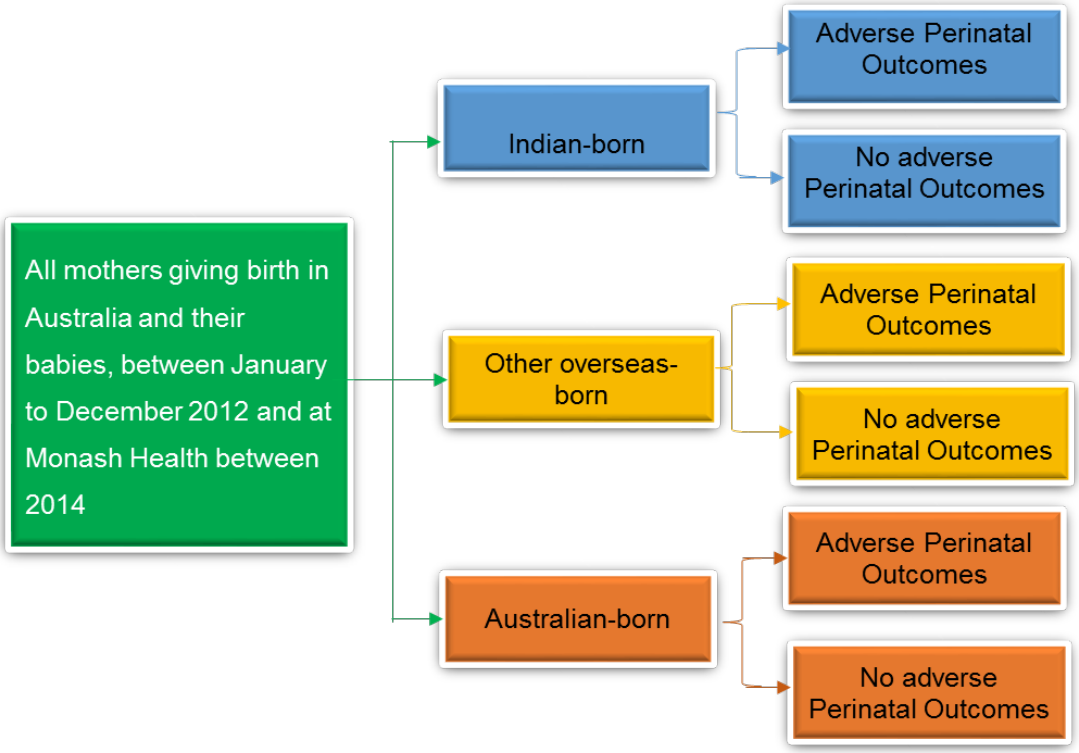


***Figure 5*. Proposed Conceptual Approach to Analysis**

3.15 Data Recoding

Data recoding is a process of conceptualising research variables and the classification of these variables into meaningful and relevant categories (Bowling, 2014). After the data was sourced, recoding was enacted. The number of digits assigned for each code depends upon the number of variables, and the codes were mutually exclusive and applied consistently for each variable (Bowling, 2014).

For example, the variable socioeconomic status was identified under Socio-Economic Indexes For Areas Index of Relative Socio-Economic Disadvantage (SEIFA IRSD), with a ranking number out of 10, corresponding to the SEIFA IRSD ranking, allocated to each case's residential area (Australian Bureau of Statistics, 2013, 2017; George,

Tennant, & Kruger, 2012). This variable was recoded as (1–2 decile=1; 3–4 decile=2; 5–6 decile=3; 7–8 decile=4; 9–10 decile=5; Not stated=6 (Appendix 8). Likewise, all the variables were recoded and analyses performed.

3.16 Data Analysis

The statistical analyses for this study included the use of descriptive and inferential statistics. Descriptive statistics were used to determine the demographic and perinatal outcomes of the study populations (Indian-born, Australian-born, and other overseas-born mothers). They yielded frequencies, numbers, and percentages for each variable, using graphs as applicable. Inferential statistics, namely both parametric and non-parametric analyses, were employed to examine the association among variables. For categorical variables, cross-tabulations with a Pearson's Chi-Square test were calculated to assess the association between each variable and a mother's country of birth. Given the number of analyses performed, a P<.001 level of significance was used to minimise the possibility of Type 1 error. Effect size were calculated for all variables and analyses performed. Kruskal Wallis tests were calculated to determine any statistically significant differences, and the individual effect size was also calculated and compared for Indian-born mothers, Australian-born mothers, and other overseas-born mothers.

3.17 Chapter Summary

This chapter has outlined information about the methodology underpinning a retrospective cohort study using a quantitative approach, and the rationale for using pre-existing perinatal data collection for the current study. The data sets were

described, followed by the data collection, data management, data recoding, data entry, and ethical approval. Furthermore, this chapter has also discussed in detail the methodological approach taken to analyse the data. Chapter four will present the findings.

CHAPTER FOUR: FINDINGS

4.1 Introduction

This research provides an opportunity to examine the association between mothers' country of birth and adverse perinatal outcomes in Australia. The previous chapter presented the methodology that guides this study. The data sets used in this study were obtained from population-level data sets, and a descriptive quantitative methodological approach was used. This chapter reports the findings from the National Perinatal Data 2012 in Section 4.2, and the Monash Health Birthing Outcomes System (BOS) data set 2014 in Section 4.3. Following this, a synthesis of the key findings from both data sets is reported in Section 4.4. Findings for National Perinatal Data set 2012 are provided in Appendix 8. Findings for Monash Health (BOS) Data set 2014 are provided in Appendix 9. A synthesis of the overall findings from both data sets is provided in Appendix 7.

4.2 Overview of National Perinatal Data 2012

Chapter Four describes the statistical findings as they relate to the research questions. This section examines the National Perinatal Data set (NPD) from the AIHW National Perinatal and Epidemiology Statistics Unit (NPESU) for the year 2012. The data is based on births reported to the perinatal data collection in each state and territory in Australia. Also provided is information relating to the incidence of adverse perinatal outcomes for all mothers giving birth in Australia in 2012. This study examines the maternal characteristics and reports the incidence of adverse perinatal outcomes for Indian-born mothers compared to Australian-born and other overseas-born mothers

giving birth in Australia. The initial overview of the study results includes demographic characteristics and resource logistics from the overall data set. The following sub-section summarises the findings from the analysis of the NPD (see Table 6).

Table 6*. Maternal Characteristics and Outcomes Among Indian-born, Australian-born and Other Overseas-born Mothers (2012)*

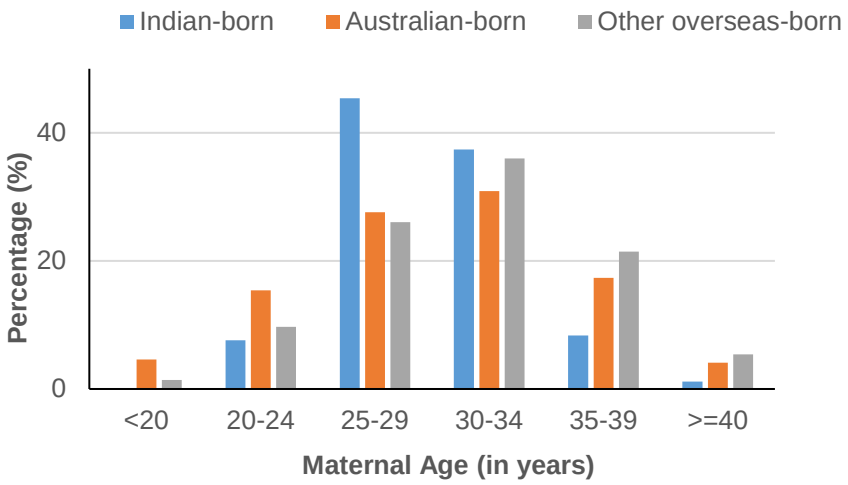
Variables	Pearson Chi-Square	df	p	Effect size V
Mothers				
Maternal age	7,336.43	10	<.001	.10
SEIFA IRSD	365.81	2	<.001	.04
Maternal parity	2,677.70	8	<.001	.06
Plurality	64.32	2	<.001	.01
Maternal marital status	5,293.02	4	<.001	.09
Maternal smoking status	7,815.41	2	<.001	.16
Maternal BMI (kg/m^2)	2,386.14	6	<.001	.08
Pregnancy at first antenatal visit in weeks	1,533.46	2	<.001	.05
Number of antenatal visits	413.35	10	<.001	.03
Intended place of birth	135.24	6	<.001	.02
Actual place of birth	204.30	6	<.001	.02
Hospital sector	2,047.30	2	<.001	.08
Method of birth	1,194.14	6	<.001	.04
Onset of labour	675.81	4	<.001	.03
Perinatal Outcomes - Babies				
Presentation	18.82	6	<.001	.01
Birth status	3.90	2	.143	.00
Gestational age (in weeks)	517.81	2	<.001	.02
Birth weight (grams)	2,545.29	2	<.001	.07
Apgar score (at 5 minutes)	7.74	2	.021	.02

4.2.1 Maternal Age

Maternal characteristics varied overall and by birth status across the three groups (i.e. Indian-born, Australian-born, and other overseas-born). As illustrated in Figure 6, the proportion of teenage mothers ≤20 years was largest among Australia-born mothers at 4.61%; followed by 1.40% for other overseas-born mothers; with Indian-born mothers recording the smallest proportion of teenage mothers (0.12%). A Chi-square test for independence was calculated, and yielded a statistically significant association between maternal age group and maternal country of birth, χ^2 (10, n = 312,184) = 7,336.43, $p < .001$, $V = .10$. A small Cohen's effect size was observed ($V = .10$). Thus, a minor association was identified between maternal age and mothers' country of birth. Percentage-wise, more Indian-born mothers were aged 25-29 and 30-34 (i.e. 25-29 – 45.38%; 30-34 – 37.39%), when compared to Australian-born mothers (i.e. 25-29 – 27.62%; 30-34 – 30.9%), and to other overseas-born mothers (i.e. 25-29 - 26.04%; 30-34 – 36.02%).

Also, the percentage of 20-24 years maternal age group was largest for Australia-born mothers (15.38%), when compared to 7.60% for Indian-born mothers, and 9.69% for other overseas-born mothers. The proportion of Indian-born mothers aged 40 and over was the smallest (1.15%) when compared to other overseas-born mother's (5.38%), and Australian-born mothers (4.12%).

***Figure 6*. Maternal Age (in years) and Country of Birth (NPD)**

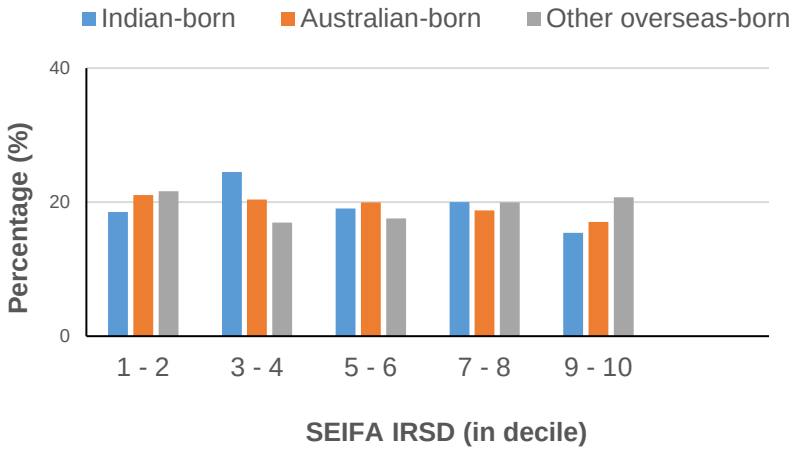


4.2.2 Socio-demographic Factors

Socio-Economic Indexes for Areas Index of Relative Socio-Economic Disadvantage (SEIFA IRSD) rank suburbs/regions according to a ten point SEIFA IRSD index scale (Australian Bureau of Statistics, 2013, 2017; George et al., 2012). A Kruskal-Wallis test was calculated, and yielded a statistically significant association in SEIFA IRSD decile across three different country of birth (Gp1, Indian-born: n = 10,037, Gp2, Australian-born: n = 209,055, Gp3, Other overseas-born: n = 84,185), χ^2 (2, n = 303,277) = 365.81, $p < .001$, $V = .04$. A small Cohen's effect size was observed ($V = .04$). Thus, a minor association was identified between SEIFA IRSD decile and mothers' country of birth.

As illustrated in Figure 7, Indian-born mothers are more likely to live in areas with a SEIFA IRSD index between 3 - 4 decile 24.48%, when compared to 20.39% of Australian-born mothers, and 16.95% of other overseas-born mothers.

***Figure 7*. SEIFA IRSD (in decile) and Maternal Country of Birth (NPD)**

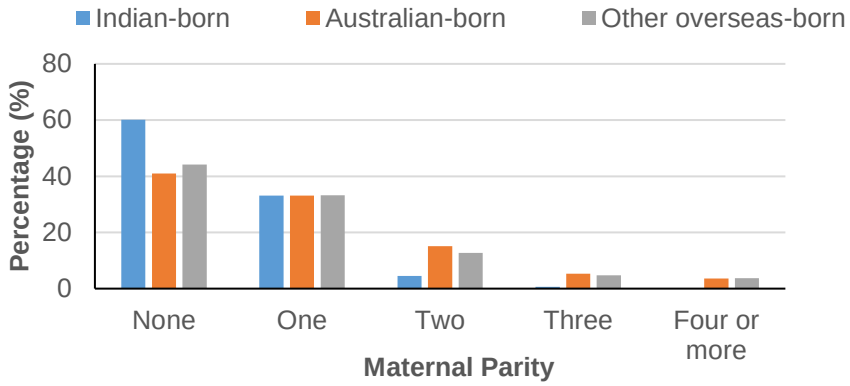


4.2.3 Maternal Parity

Maternal parity varied among the three groups. A Chi-square test for independence was calculated and yielded a statistically significant association between maternal parity and maternal country of birth, χ^2 (8, n = 306,587) = 2,677.70, $p < .001$, $V = .06$. A small Cohen's effect size was observed ($V = .06$). Thus, a minor association was identified between maternal parity and mothers' country of birth. Indian-born mothers are least likely to give birth to a third or subsequent child (0.10%) when compared to 3.58% of Australian-born mothers and 3.70% of other overseas-born mothers.

As illustrated in Figure 8, the largest proportion of mothers who have been pregnant, but have not achieved a live birth, were Indian-born mothers (60.06%). This compares to 40.94% of Australian-born mothers, and 44.13% of other overseas-born mothers.

***Figure 8*. Maternal Parity and Maternal Country of Birth (NPD)**



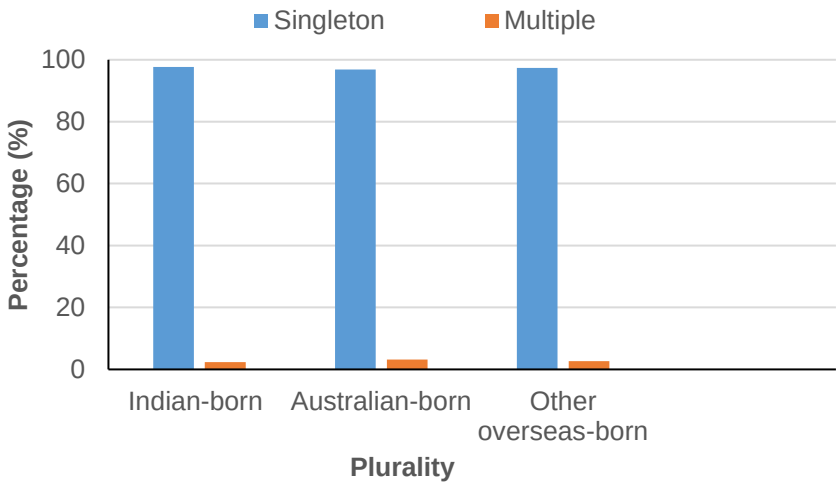
4.2.4 Plurality

Regarding plurality a Chi-square test for independence was formed, and yielded a statistically significant association between plurality and country of birth, χ^2 (2, n = 312,250) = 64.32, p < .001, V = .01. A small Cohen's effect size was observed (V = .01). Thus, a minor association was identified between plurality and mothers' country of birth.

As illustrated in Figure 9, the proportion of singleton births was smallest among Australian-born mothers (i.e. 96.86%). The proportion for Indian-born mothers was 97.63%, and for other overseas-born mothers the proportion was 97.35%. Whereas,

the percentage of multiple pluralities was largest for Australian-born mothers 3.14%, as compared to 2.37% for Indian-born mothers, and 2.65% for other overseas-born mothers.

***Figure 9*. Plurality of Birth and Maternal Country of Birth (NPD)**



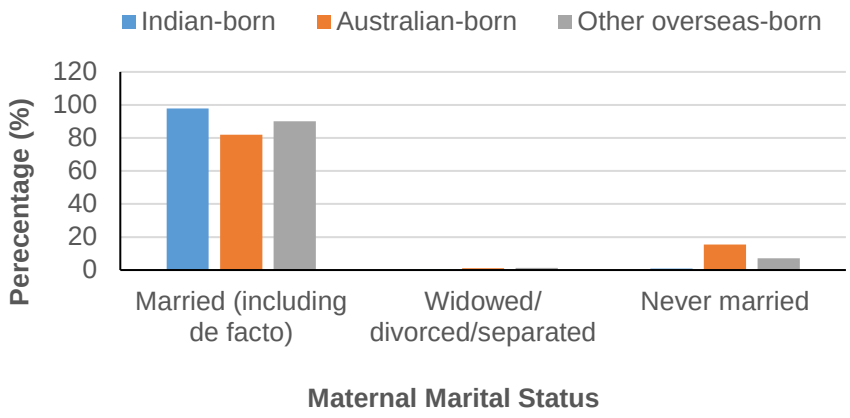
4.2.5 Maternal Marital Status

A Chi-square test for independence was performed, and yielded a statistically significant association between marital status and maternal country of birth, χ^2 (4, n = 307,356) = 5,293.02, p < .001, V = .09. A small Cohen's effect size was observed (V = .09). Thus, a minor association was identified between marital status and mothers' country of birth.

As illustrated in Figure 10, the proportion of those married (including de-facto) was largest among Indian-born mothers at 97.91%, with 81.91% for Australian-born

mothers. The proportion for other overseas-born mothers was 90.07%. Whereas, the category of 'never married' was lower for Indian-born mothers at 0.95%, when compared to 1.58% for Australian-born mothers and 1.62% for other overseas-born mothers.

***Figure 10*. Marital Status and Maternal Country of Birth (NPD)**



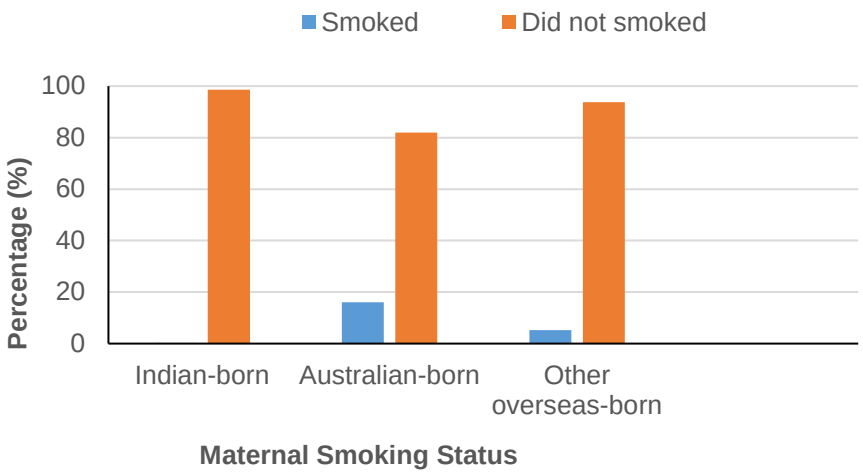
4.2.6 Maternal Smoking Status

Regarding maternal smoking status, a Chi-square test for independence was performed, and yielded a significant association between maternal smoking status and country of birth, χ^2 (2, n = 306,559) = 7,815.41, p < .001, V = .16. A medium Cohen's effect size was observed (V = .16). Thus, a medium association was identified between maternal smoking status and mothers' country of birth.

As illustrated in Figure 11, Indian-born mothers were least likely to smoke during pregnancy at 0.28%, compared to Australian-born mothers at 16% and other

overseas-born mothers at 5.25%. An interesting fact is 98.65% of Indian-born mothers did not smoke during pregnancy, whereas a rate of 82% applied to Australian-born mothers, and 93.73% to other overseas-born mothers.

***Figure 11*. Maternal Smoking Status and Country of Birth (NPD)**

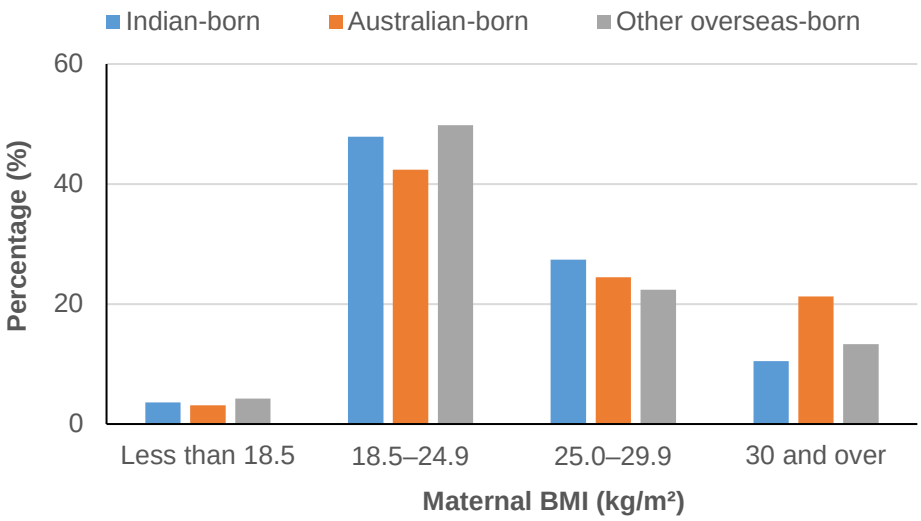


4.2.7 Maternal BMI (kg/m^2)

A Chi-square test for independence was performed, and yielded a significant association between maternal BMI (kg/m2) and country of birth, χ^2 (6, n = 189,545) = 2,386.14, p < .001, V = .08. A small Cohen's effect size was observed (V = .08). Thus, a minor association was identified between maternal BMI and mothers' country of birth.

As illustrated in Figure 12, the percentage of maternal body mass index (kg/m^2) 30+ was smallest among Indian-born mothers at 10.48%, this being the case for 13.31% of other overseas-born mothers, and 21.28% of Australian-born mothers, respectively.

***Figure 12*. Maternal BMI (kg/m^2) of Birth and Maternal Country of Birth (NPD)**



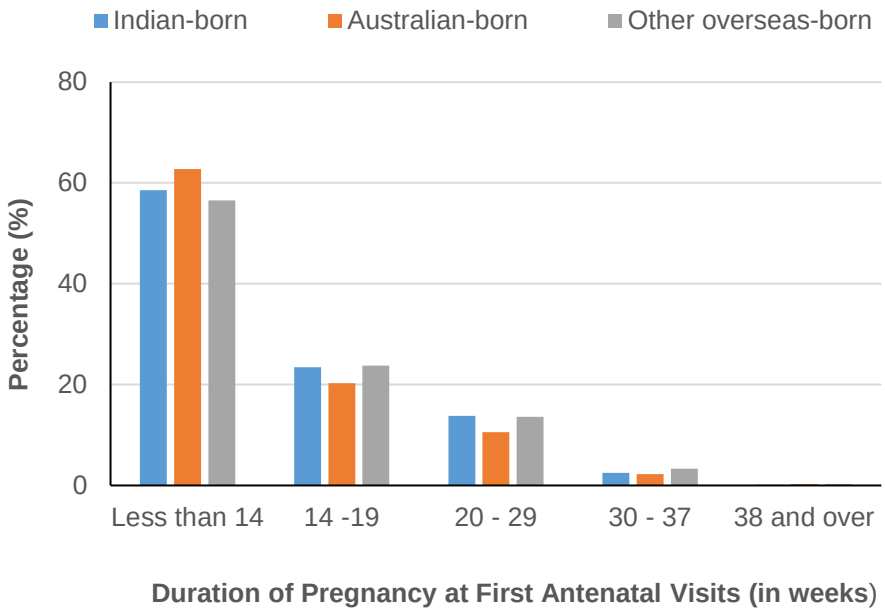
4.2.8 Duration of Pregnancy at First Antenatal Visit (in weeks)

It is recommended that pregnant women attend their first antenatal visit before the completion of the first trimester. The first antenatal visit is performed by a maternity care professional, at which time pregnancy is confirmed and duration of pregnancy calculated. A Kruskal-Wallis test was performed, and yielded a statistically significant association in duration of pregnancy at first antenatal visit (in weeks) across three different countries of birth, (Gp1, Indian-born; n = 10,145, Gp2, Australian-born; n = 206,869, Gp3, Other overseas-born: n = 84,827), χ^2 (2, n = 301,841) = 1,533.46, p <

.001, *V* = .05. A small Cohen's effect size was observed (*V* = .05). Thus, a minor association was identified between first antenatal visit and mothers' country of birth.

As illustrated in Figure 13, the percentage of mothers who had not had their first antenatal check-up before 14 weeks of pregnancy was largest among Australian-born mothers at 62.77%, when compared to 58.57% of Indian-born mothers and 56.51% of other overseas-born mothers.

***Figure 13*. Duration of Pregnancy at First Antenatal Visit (in weeks) and Maternal Country of Birth (NPD)**



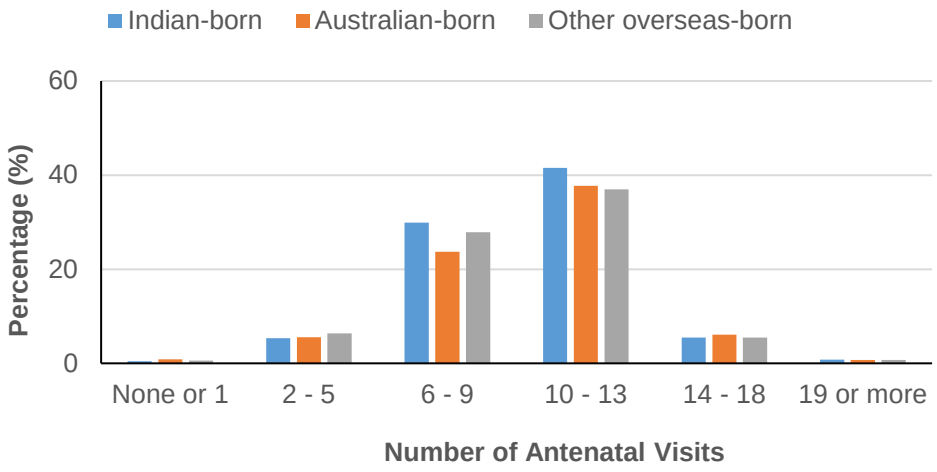
4.2.9 Number of Antenatal Visits

A Chi-square test for independence was performed, and yielded a significant association between number of antenatal visits and country of birth, χ^2 (10, n =

177,221) = 413.35, p < .001, V = .03. A small Cohen's effect size was observed (V = .03). Thus, a minor association was identified between number of antenatal visits and mothers' country of birth. The largest proportion of Indian-born mothers at 41.5% attended 10-13 antenatal visits during pregnancy, as compared to 37.73% of Australian-born mothers and 37.01% of other overseas-born mothers.

As illustrated in Figure 14, the largest percentage of mothers who attended 10-13 antenatal visits during pregnancy were Indian-born mothers 41.55%, as compared to 37.73% of Australian-born mothers and 37.01% of other overseas-born mothers.

***Figure 14*. Number of Antenatal Visit and Maternal Country of Birth (NPD)**



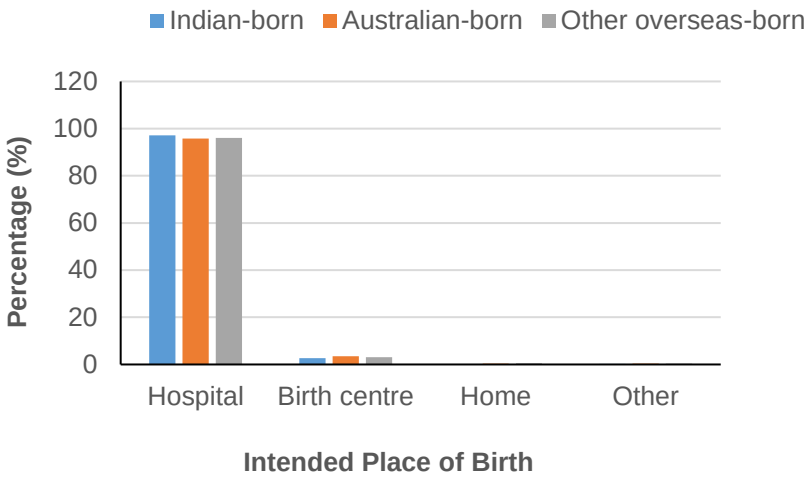
4.2.10 Intended Place of Birth

A Chi-square test for independence was performed, and yielded a significant association between intended place of birth and country of birth, χ^2 (6, n = 312,151) = 135.24, p < .001, V = .02. A small Cohen's effect size was observed (V = .02). Thus,

a minor association was identified between intended place of birth and mothers' country of birth.

As illustrated in Figure 15, the largest percentage of mothers who did not state their intended place of birth were Australian-born mothers at 87%. Whereas, only 1% of Indian-born mothers and 12 % of other overseas-born mothers did not state their intended place of birth. 97.09% of Indian-born mothers stated that their intended place of birth was a hospital, as compared to 96.06% of other overseas-born and 95.76% of Australian-born mothers.

***Figure 15*. Intended Place of Birth and Maternal Country of Birth (NPD)**



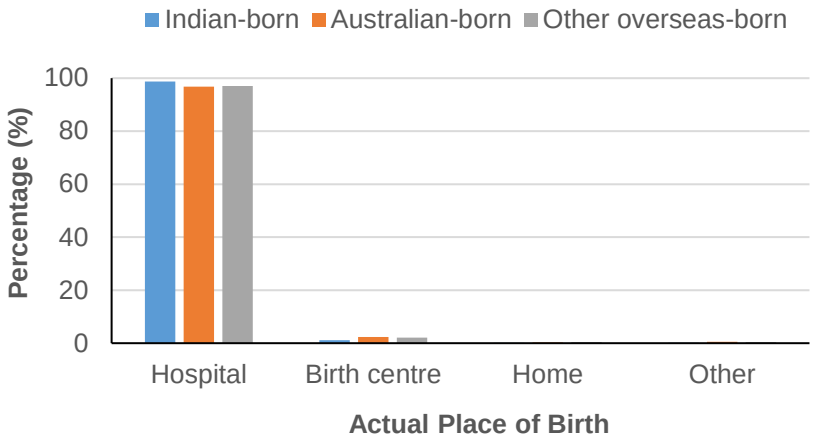
4.2.11 Actual Place of Birth

Hospitals were the actual place of birth for most of the Indian-born mothers in Australia during 2012. A Chi-square test for independence was performed, and yielded a significant association between actual place of birth and country of birth, χ^2 (6, n =

312,216) = 204.30, $p < .001$, $V = .02$. A small Cohen's effect size was observed ($V = .02$). Thus, a minor association was identified between actual place of birth and mothers' country of birth.

As illustrated in Figure 16, the largest proportion of mothers whose actual place of birth was a hospital were Indian-born mothers at 98.73%, as compared to 96.85% of Australian-born mothers and 97.01% of other overseas-born mothers.

***Figure 16*. Actual Place of Birth and Maternal Country of Birth (NPD)**



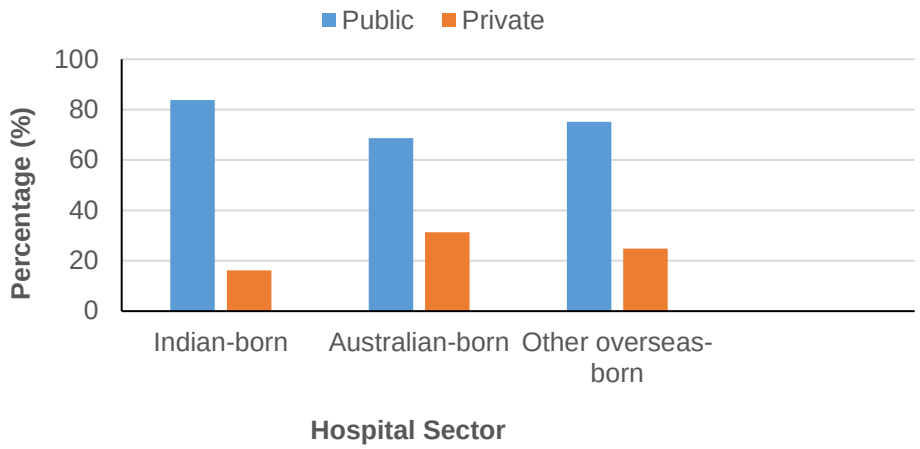
4.2.12 Hospital Sector

Most of the Indian-born mothers gave birth at a public hospital. A Chi-square test for independence was performed, and yielded a significant association between hospital sector and country of birth, χ^2 (2, n = 302,751) = 2,047.30, $p < .001$, $V = .08$. A small Cohen's effect size was observed (V = .08). Thus, while there appears to be an

association between hospital sector and mothers' country of birth, the association identified in the data was minor.

As illustrated in Figure 17, the largest percentage of mothers who gave birth at a public hospital were Indian-born mothers (83.78%), as compared to 68.67% for Australian-born mothers, and 75.11% for other overseas-born mothers. The largest proportion of mothers giving birth at a private hospital were Australian-born mothers at 31.33%.

Figure 17. **Hospital Sector and Maternal Country of Birth (NPD)**



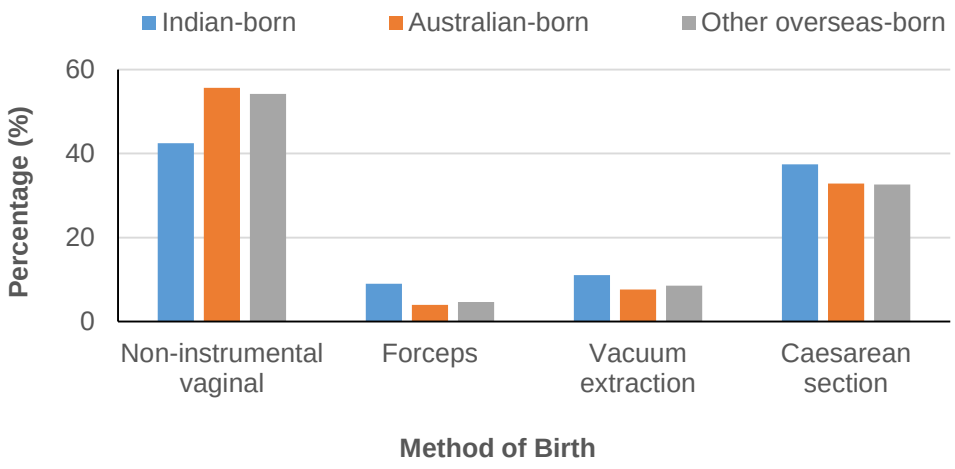
4.2.13 Method of Birth

A Chi-square test for independence was performed, and yielded a significant association between method of birth and country of birth, χ^2 (6, n = 312,228) = 1,194.14, $p < .001$, $V = .04$. A small Cohen's effect size was observed ($V = .04$). Thus, a minor association was identified between method of birth and mothers' country of birth. Only 42.47% of Indian-born mothers had a normal vaginal birth, a lower rate

when compared to 55.60% of Australian-born mothers, and 54.17% of other overseas-born mothers.

Of all births in 2012, as illustrated in Figure 18, the largest proportion of mothers who experienced a caesarean section delivery were Indian-born mothers at 37.42%, as compared to 32.82% of Australian-born mothers, and 32.62% of other overseas-born mothers. Percentage-wise, of mothers experiencing forceps or vacuum extraction (instrumental) vaginal delivery, Indian-born mothers were the largest (i.e. forceps–9.01%; vacuum extraction–11.09%) when compared to Australian-born mothers (i.e. forceps–3.95%; vacuum extraction–7.62%), and to other overseas-born mothers (i.e. forceps-4.66%; vacuum extraction–8.54%).

***Figure 18*. Method of Birth and Maternal Country of Birth (NPD)**

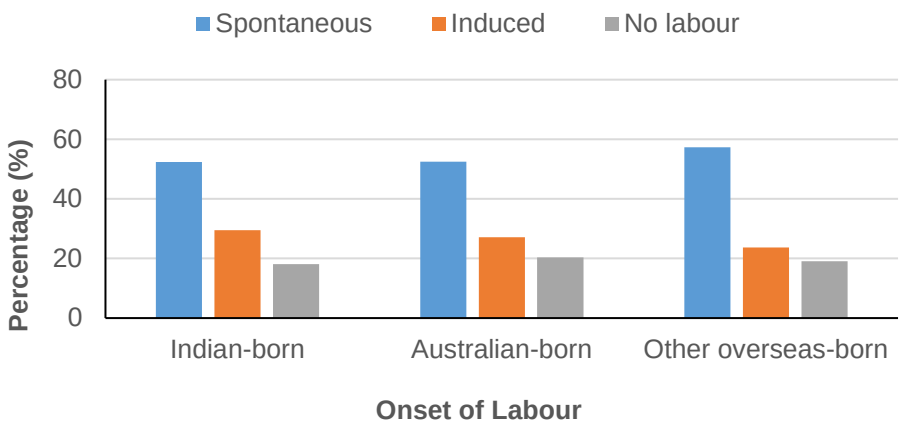


4.2.14 Onset of Labour

A Chi-square test for independence was performed, and obtained a significant association between onset of labour and maternal country of birth, χ^2 (4, n = 312,163) = 675.81, p < .001, V = .03. A small Cohen's effect size was observed (V = .03). Thus, a minor association was identified between onset of labour and mothers' country of birth.

As illustrated in Figure 19, the proportion of Indian-born mothers who experienced induced labour was largest at 29.50%, as compared to 23.65% of other overseas-born mothers and 27.15% of Australian-born mothers. Percentage-wise, other overseas-born mothers were more likely to experience spontaneous onset of labour at 57.31%, when compared to Australian-born mothers at 52.48%, and Indian-born mothers at 52.37%.

***Figure 19*. Onset of Labour and Maternal Country of Birth (NPD)**

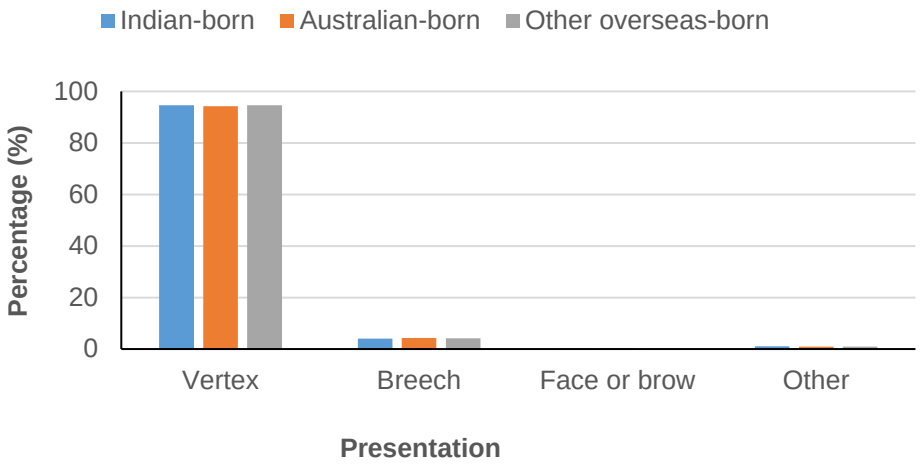


4.2.15 Presentation

There is no difference between the three maternal country of birth variables relating to the incidence of vertex and brow fetal presentations. A Chi-square test for independence was performed, and yielded a significant association between presentation and country of birth, χ^2 (6, n = 311,536) = 18.82, p < .001, V = .01. A small Cohen's effect size was observed (V = .01). Thus, a minor association was identified between some presentations and mothers' country of birth.

As illustrated in Figure 20, the percentage of other presentations including breech was largest among Indian-born mothers at 1.04%, as compared to 0.89% of Australian-born and 0.91% of other overseas-born mothers.

***Figure 20*. Presentation and Maternal Country of Birth (NPD)**

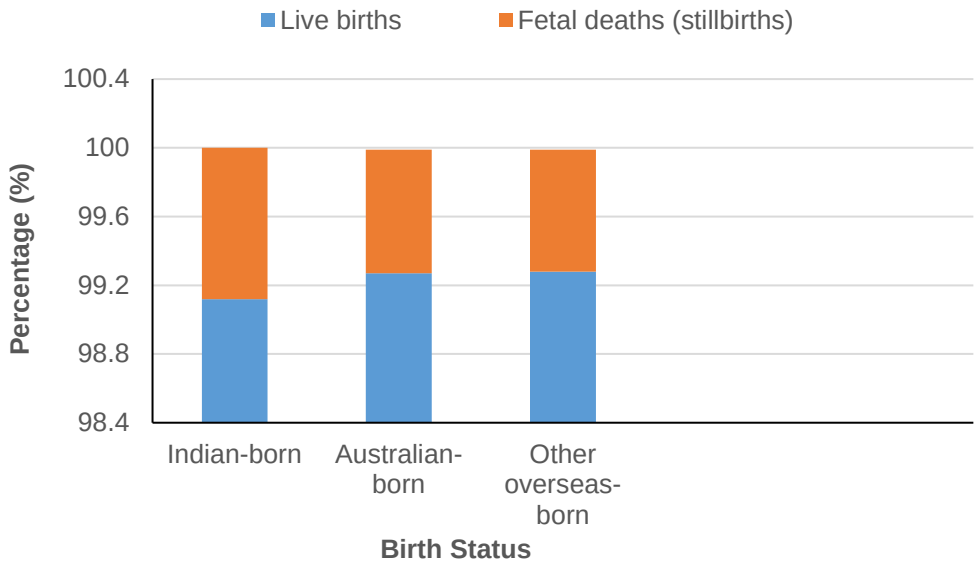


4.2.16 Birth Status

A Chi-square test for independence was performed, indicated statistically non-significant association between birth status and country of birth, χ^2 (2, n = 312,214) = 3.90, p = .143, V = .00. A small Cohen's effect size was observed (V = .00). Thus, a minor association was identified between birth status and mothers' country of birth.

As illustrated in Figure 21, a slight difference in birth status was noted between Indian-born mothers, Australia-born mothers, and other overseas-born mothers. The percentage of stillbirths was slightly largest among Indian-born mothers at 0.88%, as compared to 0.71% of other overseas-born mothers. The percentage of Australia-born mothers was at 0.72%.

***Figure 21*. Birth Status and Maternal Country of Birth (NPD)**

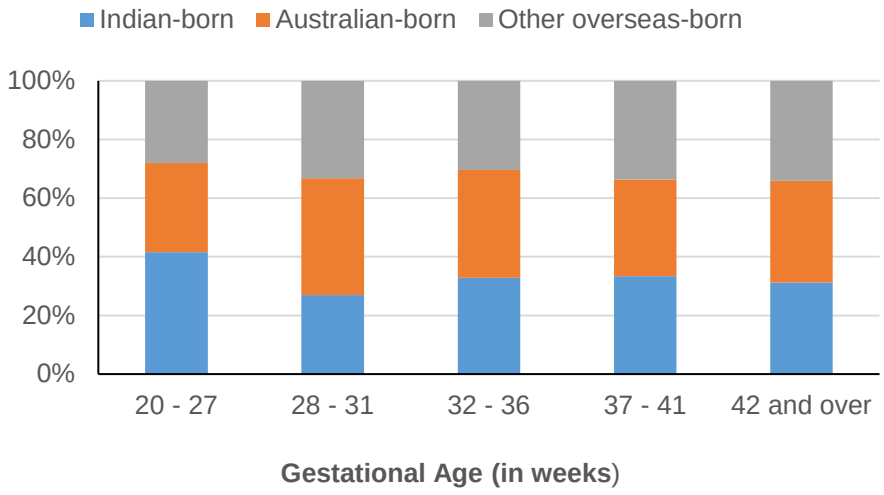


4.2.17 Gestational Age (in weeks)

A Kruskal-Wallis test was performed, and yielded a statistically significant association in gestational age (in weeks) across three three maternal country of birth variables (Gp1, Indian-born: n = 10,295, Gp2, Australian-born: n = 214,943, Gp3, Other overseas-born: n = 86,931), χ^2 (2, n = 312,169) = 517.81, p < .001. A Cramer's V = .02 was also identified. This represents a very small effect size according to Cohen (1988). Thus, a minor association was identified between gestational age and mothers' country of birth.

As illustrated in Figure 22, Indian-born mothers were at increased risk for premature birth between 20-27 weeks of gestation at 1.16%, as compared to Australian-born mothers at 0.88%, and to other overseas-born mothers at 0.78%.

***Figure 22*. Gestational Age (in weeks) of Birth and Maternal Country of Birth (NPD)**

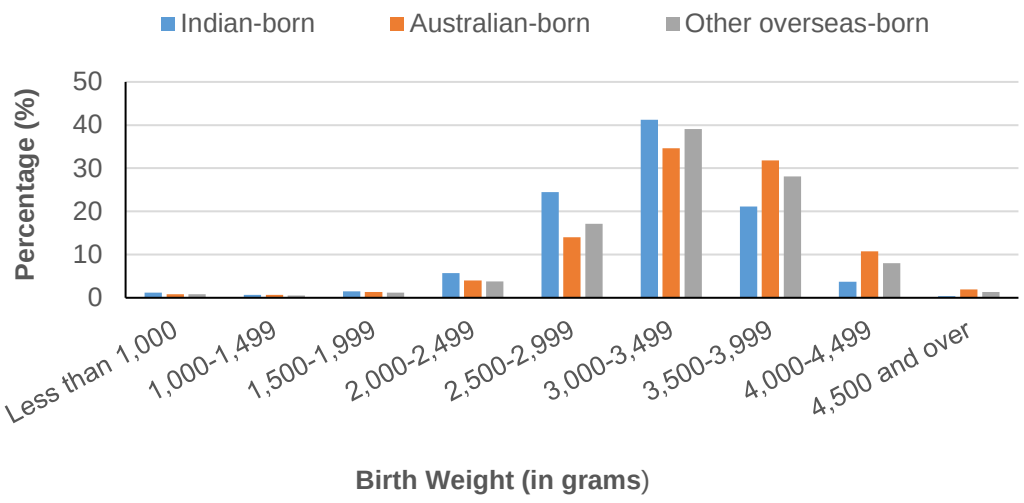


4.2.18 Birth Weight (in grams)

Birth weight was chosen as a discrete measure of adverse birth outcomes. Low birth weight (defined as less than 2,500 grams) has been significantly associated with maternal country of birth. A Kruskal-Wallis test was performed which revealed a statistically significant association in birth weight (in grams) across three maternal country of birth variables (Gp1, Indian-born: n = 10,292, Gp2, Australian-born: n = 214,865, Gp3, Other overseas-born: n = 86,893), χ^2 (2, n = 312,050) = 2,545.29, p < .001. A Cramer's V = .07 was also identified. This represents a very small effect size according to Cohen (1988). Thus, a minor association was identified between birth weight and mothers' country of birth.

As illustrated in Figure 23, percentage wise, more Indian-born mothers gave birth to babies weighing <1,000 grams (1.16%) and between 2,000-2,499 grams (5.70%), when compared to Australian-born mothers (i.e. <1,000 grams - 0.85%; 2,000-2,499 grams - 3.99%), and to other overseas-born mothers (i.e. <1,000 grams - 0.83%; 2,000-2,499 grams - 3.76%).

Figure 23. **Birth Weight (in grams) and Maternal Country of Birth (NPD)**

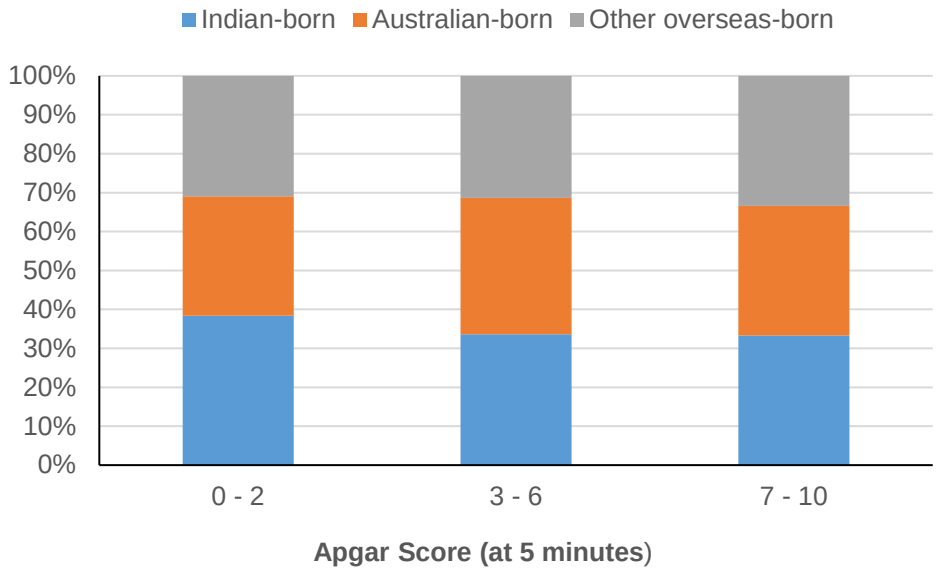


4.2.19 Apgar Score (at 5 minutes)

A Kruskal-Wallis test was performed which revealed a statistically non-significant association in Apgar score (at 5 minutes) across three different country of birth (Gp1, Indian-born: n = 10,286, Gp2, Australian-born: n = 214,606, Gp3, Other overseas-born: n = 86,819), χ^2 (2, n = 311,711) = 7.74, p = .021. A Cramer's V = .02 was also identified. This represents a very small effect size according to Cohen (1988). Thus, a minor association was identified between Apgar score (at 5 minutes) and mothers' country of birth.

As illustrated in Figure 24, the largest proportion of babies born with a life threatening Apgar score (0 – 2) at 5 minutes were Indian-born mothers at 1.14%, as compared to 0.91% of Australian-born mothers and 0.92% of other overseas-born mothers.

Figure 24. **Apgar Score (at 5 minutes) of Birth and Maternal Country of Birth (NPD)**



4.3 Overview of Monash Health (BOS) Data 2014

This section describes the findings of the Monash Health (BOS) Data set for 2014. Monash Health includes three different maternity services, and offers mothers three models of maternity care:

1. Antenatal clinic at one of the three hospital sites;
2. Shared care involving the hospital and an affiliated general practioner (GP) or midwife in the community; and,
3. Private care with a specialist obstetrician or a general practioner (GP) obstetrician in the community.

The Birthing Outcomes System (BOS) records data for all births within the Monash Health service. In the absence of an identified pregnancy risk, pregnant women are encouraged to choose a preferred model of care:

1. Priority access is given to Monash Medical Centre (MMC) for women requiring tertiary level care or residing close to Clayton.
2. Priority access to Dandenong is for local women and those requiring secondary level care.
3. Priority access to Casey Hospital, Berwick, is for the needs of the many new families residing in that district.

For Medicare eligible Australian residents, Monash Health uses a Midwife Assessment Clinic (MAC) for all public patients responsible for confirmation of pregnancy, and a comprehensive antenatal risk assessment based on a booking at the most appropriate level of care is determined. Each pregnancy is recorded in the Birthing Outcome

System at the initial antenatal hospital visit, and updated through to birth and hospital discharge.

The Monash Health (BOS) Hospital Data is recorded at the individual level and includes the following information: maternal medical condition; obstetric complications; past medical history; and neonatal morbidity related data. This section reports the findings associated with Indian-born mothers' adverse birth outcomes when giving birth at Monash Health Australia, as compared to Australian-born and other overseas-born mothers for the year 2014. The Monash Health (BOS) Hospital data set involves a population of over 3,000 births, representing all births that occurred across the three campuses of Monash health in 2014. The initial overview of the study results includes demographic characteristics and resource logistics from the overall data set. The maternal characteristics and outcomes among Indian-born mothers, Australian-born mothers, and other overseas-born mothers for the total data set 2014 are recorded in Table 7.

Table 7. ***Maternal Characteristics and Outcomes Among Indian-born, Australian-born and Other Overseas-born Mothers (2014)***

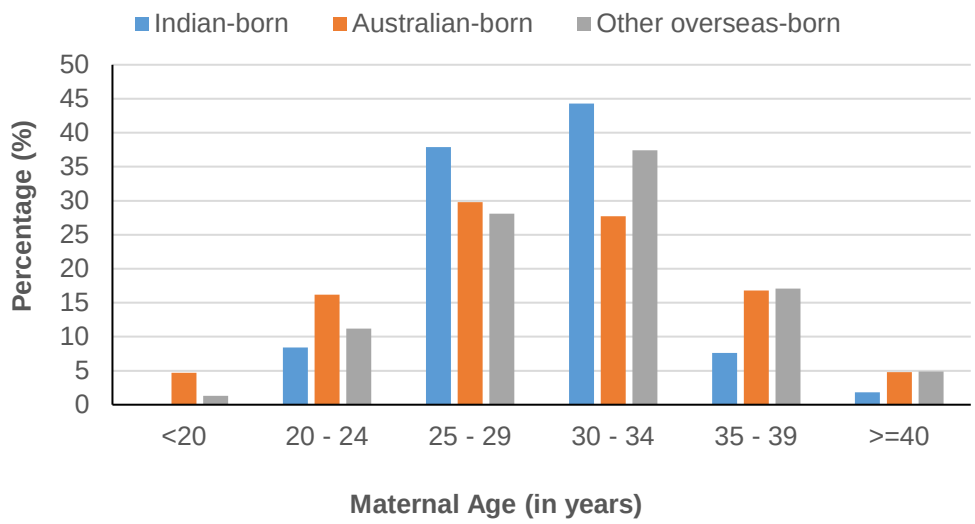
Variables	Pearson Chi-Square	df	p	Effect size V
Mothers				
Maternal age	131.62	10	<.001	.14
Maternal parity	93.93	8	<.001	.12
Plurality	1.00	2	.606	.02
Maternal marital status	306.35	4	<.001	.22
Substance abuse	318.14	14	<.001	.22
Maternal medical conditions	318.14	14	<.001	.22
Past history	423.39	44	<.001	.21
Method of birth	47.77	8	<.001	.09
Onset of labour	29.89	4	<.001	.07
Perinatal Outcomes - Babies				
Presentation	13.13	6	<.001	.05
Birth status	1.24	2	.538	.02
Gestational age (in weeks)	2.98	2	.225	.03
Birth weight (grams)	63.27	2	<.001	.11
Apgar score (at 5 minutes)	0.27	2	.872	.01
Admission to special care nurseries or neonatal intensive care units	17.42	6	.008	.05
Neonatal morbidity	100.76	48	<.001	.13
Birth defect	33.49	22	.055	.07
Obstetric complications	160.55	48	<.001	.16

4.3.1 Maternal Age

The maternal characteristics of the data in 2014 indicate that there were 1,211 Australian-born mothers, 393 Indian-born mothers, and 1,568 other overseas-born mothers giving birth in 2014. Maternal characteristics varied overall and by nativity status among the three groups. A Chi-square test for independence was performed, and yielded a statistically significant association between maternal age group and country of birth, χ^2 (10, n = 3,172) = 131.62, $p < .001$, $V = .14$. A medium Cohen's effect size was observed ($V = .14$). Thus, a medium association was identified between maternal age group and mothers' country of birth. Percentage-wise, the largest proportion of mothers aged 25-29 and 30-34 giving birth in 2014 were Indian-born mothers (i.e. 25–29 - 37.9%; 30-34 - 44.3%), as compared to Australian-born mothers (i.e. 25–29 - 29.8%; 30-34 - 27.7%), and to other overseas-born mothers (i.e. 25–29 - 28.1%; 30-34 - 37.4%).

As illustrated in Figure 25, the overall proportion of teenage mothers younger than 20 years of age was very limited amongst Indian-born mothers at 0.0%, when compared to 4.7% for Australian-born mothers. The proportion for other overseas-born mothers was 1.3%. Whereas, for a maternal age between 20-24 years, Australia-born mothers were the largest at 16.2%, as opposed to other overseas-born mothers at 11.2%, and Indian-born mothers at 8.4%. Also, the proportion of maternal age 40 and over was smallest among Indian-born mothers at 1.8% when compared to other overseas-born mothers at 4.9%, and Australian-born mothers at 4.8%.

Figure 25. **Maternal Age (in years) and Country of Birth (MHD)**



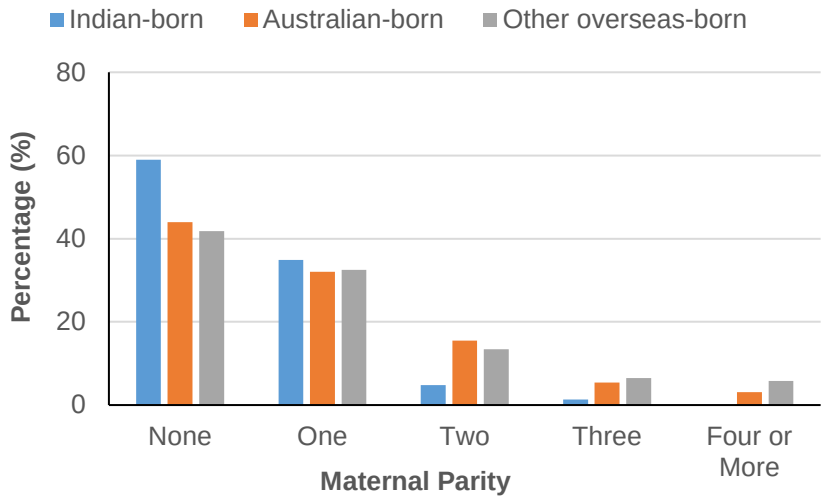
4.3.2 Maternal Parity

Maternal parity varied across the three groups. A Chi-square test for independence was performed, and yielded a statistically significant association between maternal parity and country of birth, χ^2 (8, n = 3,172) = 93.93, p < .001, V = .12. A medium Cohen's effect size was observed (V = .12). Thus, a medium association was identified between maternal parity and mothers' country of birth. The largest proportion of mothers who have been pregnant but have not achieved a live birth was Indian-born mothers at 59.0%, as compared to 44.0% of Australian-born mothers, and 41.18% of other overseas-born mothers.

As illustrated in Figure 26, Indian-born mothers are less likely to give birth to a third or subsequent child at 1.3%, when compared to 3.58% of Australian-born mothers and 5.8% of other overseas-born mothers. Percentage-wise, of mothers, giving birth to

only one child, more Indian-born mothers gave birth during 2014 (i.e. one child - 34.9%) than compared to Australian-born mothers (i.e. one child - 32.0%) and to other overseas-born mothers (i.e. one child - 32.5%).

Figure 26. **Maternal Parity and Country of Birth (MHD)**



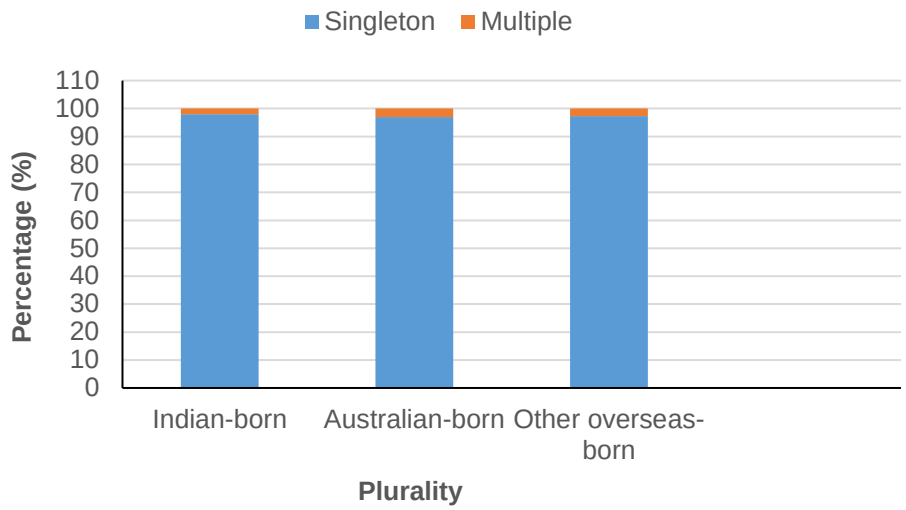
4.3.3 Plurality

Regarding multiple births, a Chi-square test for independence was performed, and yielded a statistically non-significant association between plurality and country of birth, χ^2 (2, n = 3,172) = 1.00, p = .606, V = .02. A small Cohen's effect size was observed (V = .02). Thus, a minor association was identified between maternal plurality and mothers' country of birth.

As illustrated in Figure 27, the largest proportion of mothers who had a singleton birth were Indian-born mothers at 98.0%, with 97.0% of Australian-born mothers also

having a singleton birth. The proportion for other overseas-born mothers was 97.3%. Whereas, the percentage of multiple pluralities was largest among 3.0% of Australian-born mothers when compared to 2.0% of Indian-born mothers and 2.7% of other overseas-born mothers.

***Figure 27*. Plurality and Maternal Country of Birth (MHD)**

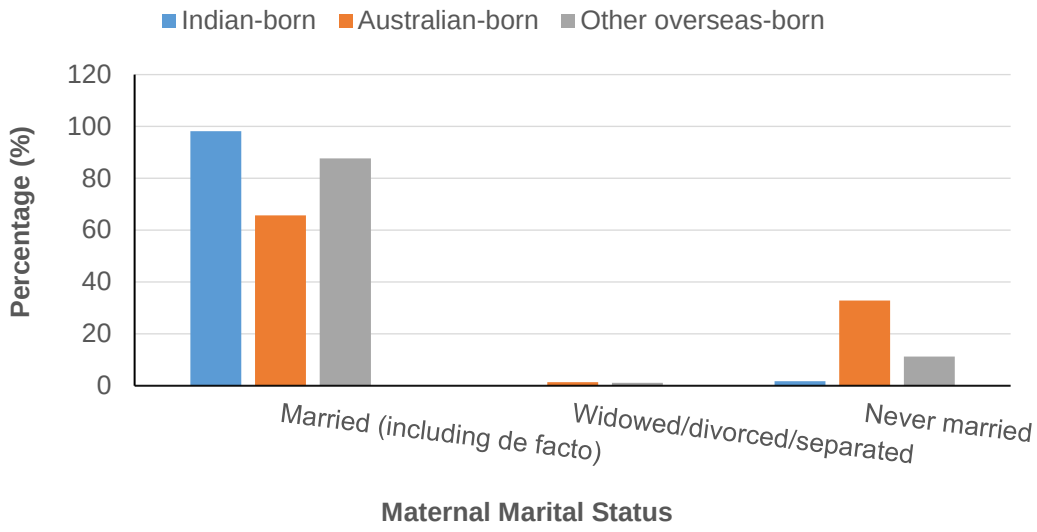


4.3.4 Maternal Marital Status

Indian-born mothers were most likely to be married (including de-facto), a Chi-square test for independence was performed, and yielded a statistically significant association between marital status and country of birth, χ^2 (4, n = 3,172) = 306.35, $p < .001$, V = .22. A medium Cohen's effect size was observed (V = .22). Thus, a medium association was identified between maternal marital status and mothers' country of birth.

As illustrated in Figure 28. The largest proportion of married women (including de-facto) was among Indian-born mothers at 98.2%, as compared to 65.7% of Australian-born mothers, and 87.7% of other overseas-born mothers. Indian-born mothers were the least likely, at 1.8%, to be never married when compared to 32.9% of Australian-born mothers, and 11. 2% of other overseas-born mothers.

***Figure 28*. Maternal Marital Status and Country of Birth (MHD)**

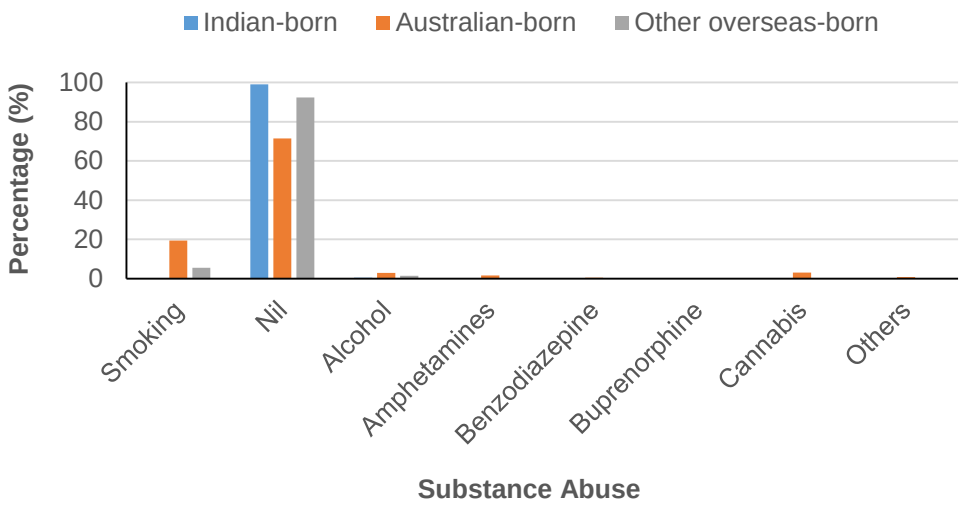


4.3.5 Substance Abuse

Regarding substance abuse, a Chi-square test for independence was calculated, and yielded a significant association between maternal substance abuse and country of birth, χ^2 (14, n = 3,172) = 318.14, $p < .001$, $V = .22$. A medium Cohen's effect size was observed ($V = .22$). Thus, a medium association was identified between maternal substance abuse and mothers' country of birth.

As illustrated in Figure 29, the smallest proportion of mothers smoking during pregnancy were Indian-born mothers at 0.3%, while 19.4% of Australian-born mothers smoked during pregnancy. The proportion of other overseas-born mothers who smoked during pregnancy was at 5.5%. Percentage-wise, of mothers giving birth during 2014, more Australian-born mothers were likely to use Cannabis during pregnancy (i.e. Cannabis-3.1%), as compared to Indian-born mothers (i.e. Cannabis–0.0%) and to other overseas-born mothers Cannabis (i.e. Cannabis-0.4%). The largest proportion at 99.0% of Indian-born mothers did not abuse substances during pregnancy, as compared to 71.4% of Australian-born mothers, and 92.3% of other overseas-born mothers.

***Figure 29*. Substance Abuse and Maternal Country of Birth (MHD)**

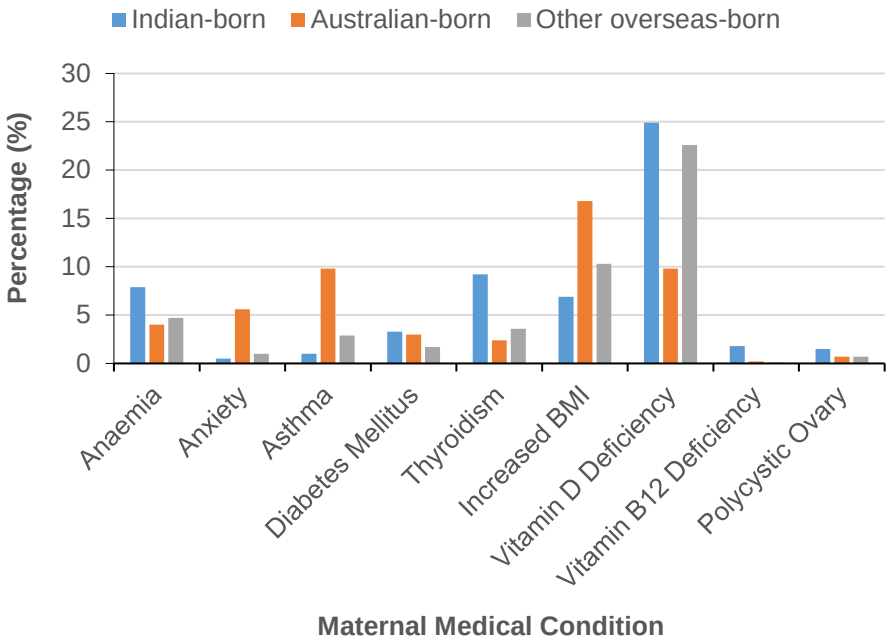


4.3.6 Maternal Medical Conditions

A Chi-square test for independence was calculated, and yielded a significant association between maternal medical condition and country of birth, χ^2 (14, n = 3,172) = 318.14, p < .001, V = .22. A medium Cohen's effect size was observed (V = .22). Thus, a medium association was identified between maternal medical condition and mothers' country of birth.

The majority of maternal medical conditions were routinely not collected and not included in the data set. Moreover, the largest proportion of unstated medical conditions were from other overseas-born mothers at 40.8%, as compared to Indian-born mothers at 34.4% and Australian-born mothers at 29.0% (as ahown in Table 47). Among the collected medical conditions, as illustrated in Figure 30, the medical conditions of diabetes mellitus, Vitamin D deficiency, Vitamin B12 deficiency, polycystic ovary, and thyroidism were highest among Indian-born mothers who gave birth during 2014 (i.e. diabetes mellitus-3.3%; Vitamin D deficiency-24.9%; Vitamin B12 deficiency-1.8%; polycystic ovary-1.5%; thyroidism-9.2%), as compared to Australian-born mothers (i.e. diabetes mellitus–3.0%; Vitamin D deficiency-9.8%; Vitamin B12 deficiency-0.2%; polycystic ovary-0.7%; thyroidism-2.4%), and to other overseas-born mothers (i.e. diabetes mellitus–1.7% ; Vitamin D deficiency-22.6%; Vitamin B12 deficiency-0.1%; polycystic ovary–0.7%; thyroidism–3.6%). The largest proportion of Indian-born mothers at 7.9% were prone to anaemia, as compared to 4.7% for other overseas-born mothers and 4.0% for Australia-born mothers. The rates of anxiety, asthma and increased BMI were largest among Australian-born mothers (5.6%, 9.8%, and 16.8%), when compared to other overseas-born mothers (1.0%, 2.9%, and 10.3%) and Indian-born mothers (0.5%, 1.0%, and 6.9%).

***Figure 30*. Maternal Medical Condition and Country of Birth (MHD)**



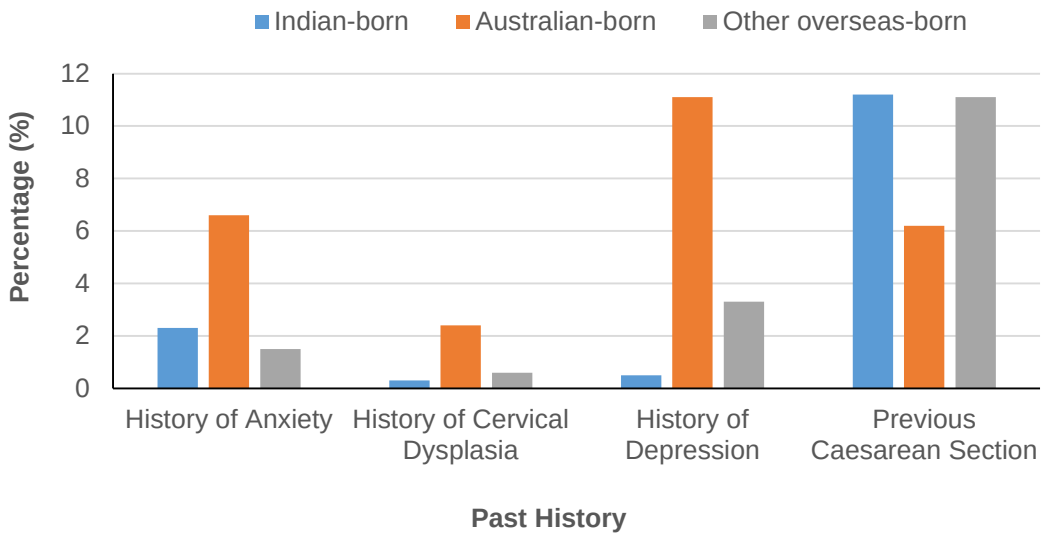
4.3.7 Past History

A Chi-square test for independence was calculated, and yielded a significant association between past history and maternal country of birth, χ^2 (44, n = 3,172) = 423.39, p < .001, V = .21. A medium Cohen's effect size was observed (V = .21). Thus, a medium association was identified between maternal past history and mothers' country of birth.

Most of the maternal past history was not routinely collected in the data set. The largest proportion of mothers not stating a past history were Indian-born mothers at 74.6%, as compared to 50.0% of Australian-born mothers, and 64.7% of other overseas-born mothers. Of the collected data, as shown in Figure 31, the largest percentage of

previous caesarean section was 11.2% for Indian-born mothers, as compared to 11.1% for other overseas-born mothers, and 6.2% for Australian-born mothers. Percentage-wise, the history of anxiety and cervical dysplasia in mothers was higher among Australian-born mothers who gave birth during 2014 (i.e. history of anxiety–6.6%; history of cervical dysplasia–2.4%), than in Indian-born mothers (i.e. history of anxiety–2.3%; history of cervical dysplasia–0.3%), and in other overseas-born mothers (i.e. history of anxiety–1.5%; history of cervical dysplasia–0.6%). The largest proportion of a history of depression presented in Australian-born mothers at 11.1%, as compared to 0.5% of Indian-born mothers and 3.3% of other overseas-born mothers.

***Figure 31*. Past History and Maternal Country of Birth (MHD)**

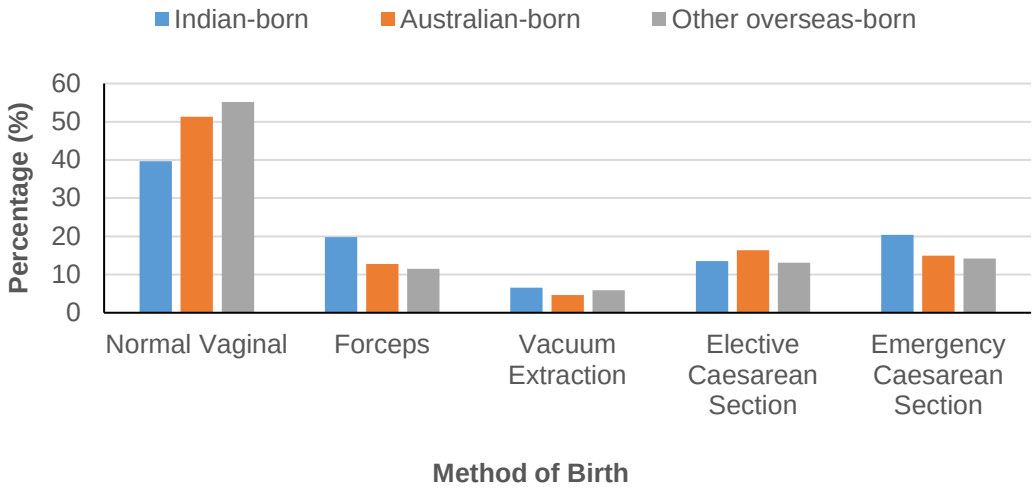


4.3.8 Method of Birth

A Chi-square test for independence was calculated, and yielded a significant association between method of birth and maternal country of birth, χ^2 (8, n = 3,172) = 47.77, p < .001, V = .09. A small Cohen's effect size was observed (V = .09). Thus, a minor association was identified between method of birth and mothers' country of birth.

Of all births in 2014, Figure 32 indicates that only 39.7% of Indian-born mothers had a normal vaginal birth. This represented a decrease from that in Australian-born mothers at 51.3%, and other overseas-born mothers at 55.2%. Percentage-wise, of babies born by a forceps or vacuum extraction instrumental vaginal delivery, an increase was observed among Indian-born mothers who gave birth during 2014 (i.e. forceps–19.1%; vacuum extraction–6.6%) when compared to that in Australian-born mothers (i.e. forceps–12.8%; vacuum extraction–4.6%) and to other overseas-born mothers (i.e. forceps–11.5%; vacuum extraction–5.9%). Elective caesarean section was largest among Australian-born mothers at 16.4%, as compared to 13.5% among Indian-born and 13.1% among other overseas-born mothers. The largest percentage of 20.4% of Indian-born mothers experienced emergency caesarean section delivery, as compared to 14.9% of Australian-born mothers and 14.2% of other overseas-born mothers.

***Figure 32*. Method of Birth and Maternal Country of Birth (MHD)**

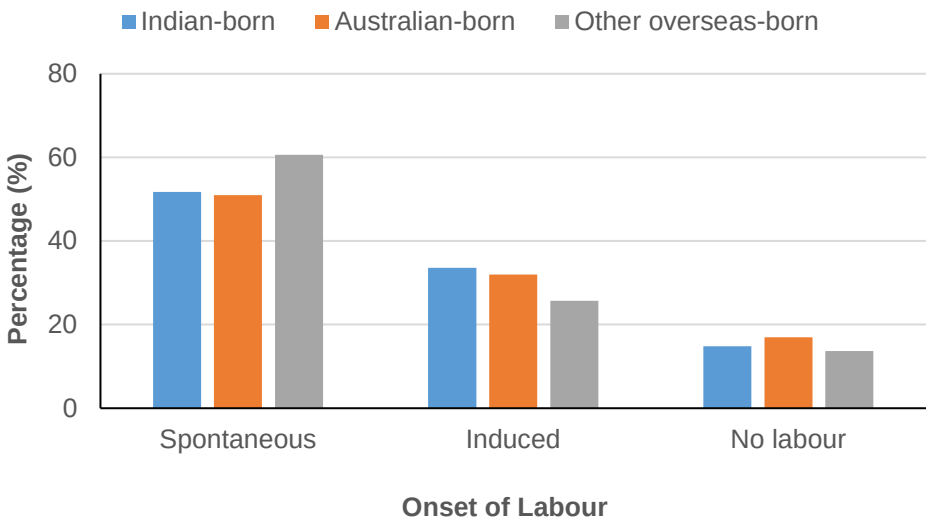


4.3.9 Onset of Labour

A Chi-square test for independence was calculated, and yielded a significant association between onset of labour and country of birth, χ^2 (4, n = 3,172) = 29.89, p < .001, V = .07. A small Cohen's effect size was observed (V = .07). Thus, a minor association was identified between onset of labour and mothers' country of birth.

As illustrated in Figure 33, the largest proportion of mothers who had induced labour were Indian-born mothers at 33.6%, with 25.7% of other overseas-born mothers also having induced labour. The proportion of Australian-born mothers with induced labour was 32.0%. The largest proportion of mothers who had spontaneous labour were overseas-born mothers (i.e. spontaneous labour-60.6%). In comparison, the proportions of both Australian-born mothers (i.e. spontaneous labour-51.0%) and Indian-born mothers (i.e. spontaneous labour-51.7%) were lower.

***Figure 33*. Onset of Labour and Maternal Country of Birth (MHD)**



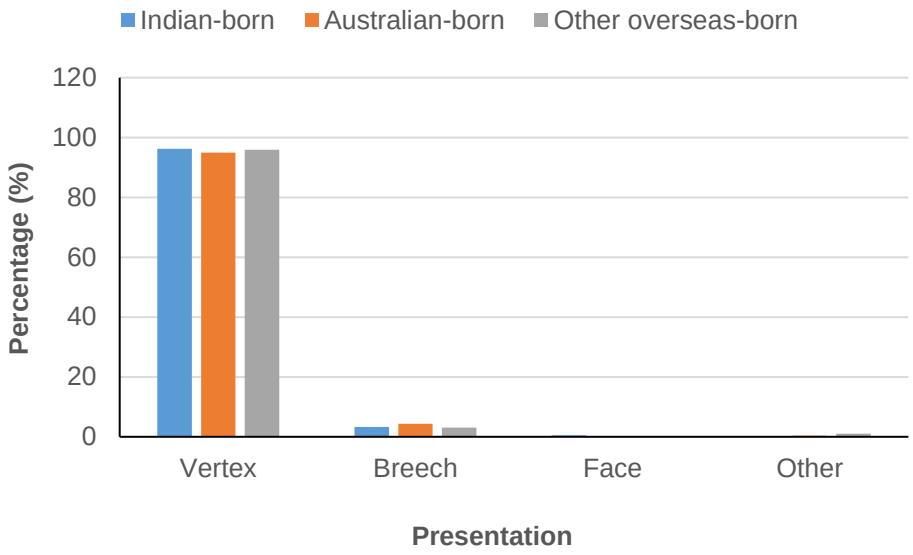
4.3.10 Presentation

In vertex presentations, no meaningful difference was found to exist between mothers from the three maternal birth regions. A Chi-square test for independence was calculated, and yielded statistically non-significant association between presentation and country of birth, χ^2 (6, n = 3,172) = 13.13, p = .041, V = .05. A small Cohen's effect size was observed (V = .05). Thus, a minor association was identified between presentation and mothers' country of birth.

As shown in Figure 34, the percentage rate of mothers who had other presentations was 96.2% for Indian-born mothers, 95.0% for Australian-born mothers, and 95.9% for other overseas-born mothers. For breech presentations, on the other hand, the

largest proportion was expressed by Australian-born mothers at 4.4%, with 3.3% for Indian-born mothers, and 3.1% for other overseas-born mothers.

***Figure 34*. Presentation and Maternal Country of Birth (MHD)**



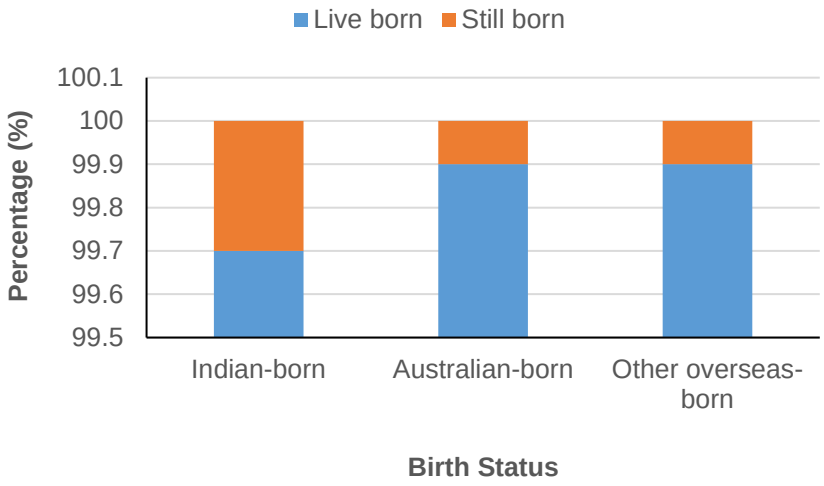
4.3.11Birth Status

In regard to birth status, a Chi-square test for independence was calculated, indicated statistically non-significant association between birth status and country of birth, χ^2 (2, n = 3,172) = 1.24, p = .538, V = .02. A small Cohen's effect size was observed (V = .02). Thus, a minor association was identified between birth status and mothers' country of birth.

As illustrated in Figure 35, a slight difference was noted between Indian-born mothers, Australia-born mothers, and other overseas-born mothers. A slightly larger percentage

of stillbirths at 0.3% was detected for Indian-born mothers, against 0.1% for both other overseas-born mothers and Australia-born mothers.

***Figure 35*. Birth Status and Maternal Country of Birth (MHD)**

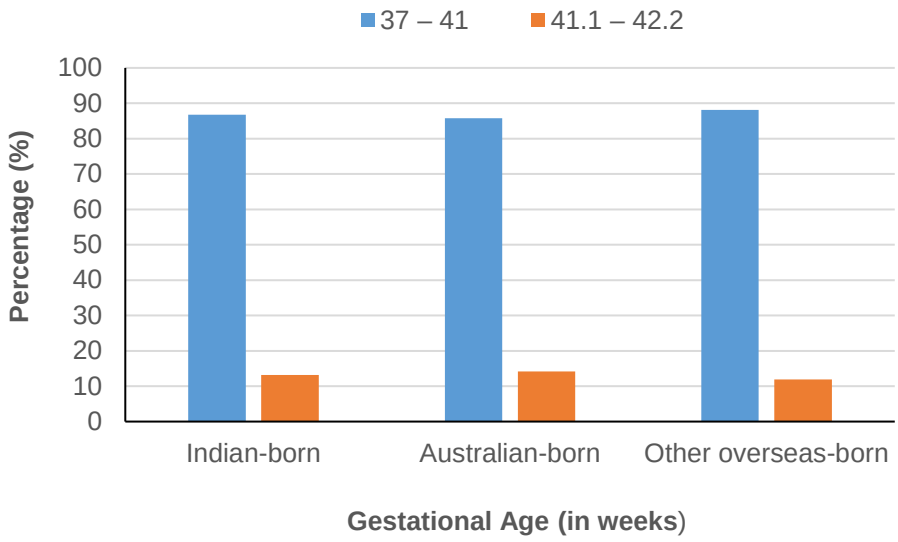


4.3.12 Gestational Age (in weeks)

Gestational age was recorded only from 37 weeks to 42.2 weeks of gestation in Monash Health (BOS) Data set. A Kruskal-Wallis test was calculated, and yielded a statistically non-significant association in gestational age (in weeks) across the three different categories of birth (Gp1, n = 392: Indian-born, Gp2, n = 1,204: Australian-born, Gp3, n = 1,560: Other overseas-born), χ^2 (2, n = 3,156) = 2.98, p = .225. A Cramer's V = .03 was also identified. This represents a small effect size according to Cohen (1988). Thus, a minor association was identified between gestational age and mothers' country of birth.

As illustrated in Figure 36, the largest percentage of, mothers who had a birth between 37-41 weeks gestation during 2014 was largest for other overseas-born mothers (i.e. 37-41 weeks - 88.1%) when compared to Australian-born mothers (i.e. 37–41 weeks – 85.8%), and to Indian-born mothers (i.e. 37–41 weeks – 86.8%).

***Figure 36*. Gestational Age (in weeks) and Maternal Country of Birth (MHD)**



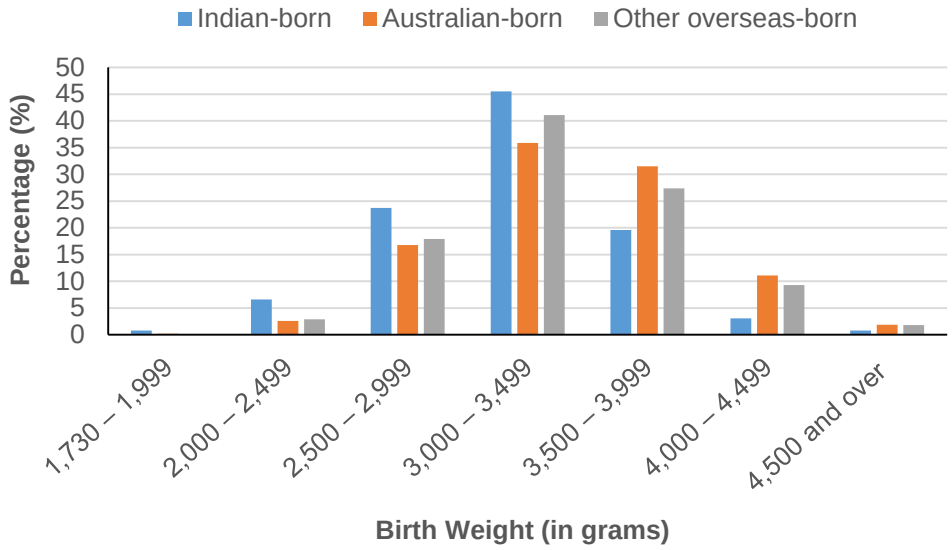
4.3.13 Birth Weight (in grams)

Birth weight was chosen as a distinct measure for adverse birth outcomes. Low birth weight (defined as lower than 2,500 grams) has been significantly associated with maternal country of birth. A Kruskal-Wallis test was calculated, and yielded statistically significant association in birth weight (in grams) across the three different categories of birth (Gp1, Indian-born: n = 392, Gp2, Australian-born: n = 1,204, Gp3, Other overseas-born: n = 1,560), χ^2 (2, n = 3,156) = 63.27, $p < .001$. A Cramer's V = .11 was also identified. This represents a medium effect size according to Cohen (1988). Thus,

an intermediate association was identified between birth weight and mothers' country of birth.

As illustrated in Figure 37, the incidence of babies birth weight <1,730 – 1,999 grams was largest percentage-wise among Indian-born mothers who gave birth during 2014 (i.e. <1,730–1,999 grams – 0.8%), when compared to Australian-born mothers (i.e. <1,730–1,999 grams – 0.2%) and other overseas-born mothers (i.e. <1,730–1,999 grams – 0.1%). The largest proportion for babies weighing 2,000-2,499 grams was for Indian-born mothers at 6.6%, as compared to 2.6% of Australian-born mothers and 2.9% of other overseas-born mothers.

***Figure 37*. Birth Weight (in grams) and Maternal Country of Birth (MHD)**

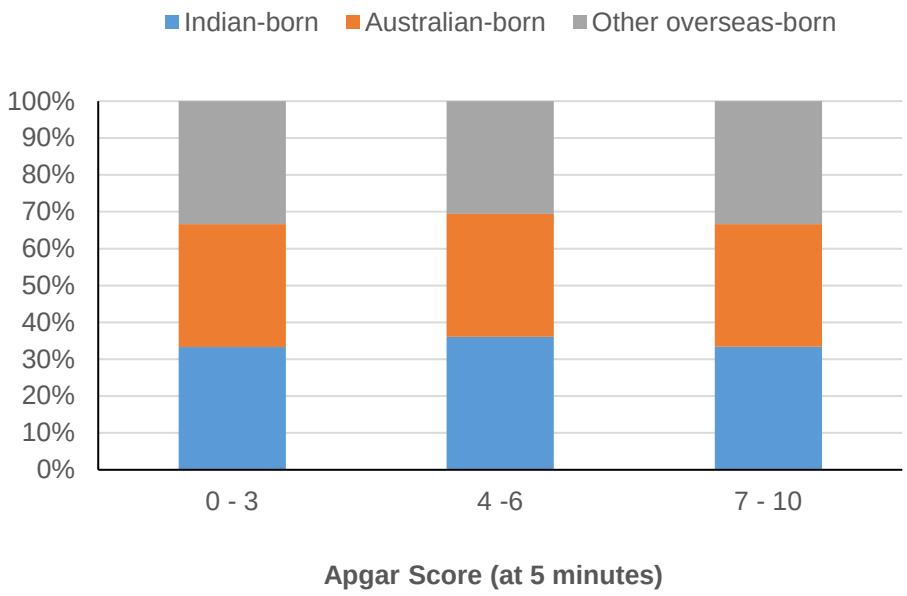


4.3.14 Apgar Score (at 5 minutes)

A Kruskal-Wallis test was calculated, and yielded statistically non-significant significant association in Apgar score (at 5 minutes) across the three different categories of birth (Gp1, Indian-born: n = 392, Gp2, Australian-born: n = 1,204, Gp3, Other overseas-born: n = 1,560), χ^2 (2, n = 3,156) = 0.27, p = .872. A Cramer's V = .01 was also identified. This represents a very small effect size according to Cohen (1988). Thus, a minor association was identified between gestational age and mothers' country of birth.

In regard to Apgar score at 5 minutes (4–6), as illustrated in Figure 38, the largest proportion of babies born with Apgar score at 5 minutes (4–6) were Indian-born mothers at 1.3%, with 1.2% for Australian-born mothers, and 1.1% for other overseas-born mothers.

***Figure 38*. Apgar Score (at 5 minutes) and Maternal Country of Birth (MHD)**

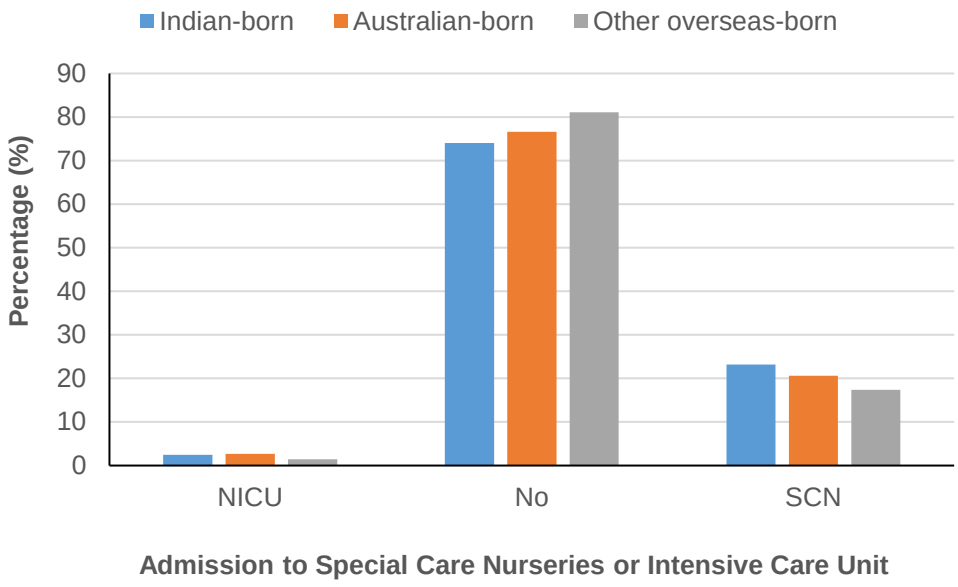


4.3.15 Admission to Special Care Nurseries or Neonatal Intensive Care Units

A Chi-square test for independence was calculated, and yielded statistically non-significant association between admission to special care nurseries or neonatal intensive care units and country of birth, χ^2 (6, n = 3,172) = 17.42, p = .008, V = .05. A small Cohen's effect size was observed (V = .05). Thus, a minor association was identified between admission to special care nurseries or neonatal intensive care units and mothers' country of birth.

As illustrated in Figure 39, the proportion of mothers whose babies were admitted to neonatal intensive care unit were Australian-born mothers at 2.7%, as compared to 2.5% for Indian-born mothers, and 1.4% for other overseas-born mothers. The percentage of babies admitted to special care nurseries was largest among Indian-born mothers at 23.2%, as compared to 20.6% for Australian-born mothers and 17.4% for other overseas-born mothers.

***Figure 39*. Admission to Special Care Nurseries or Neonatal Intensive Care Units and Maternal Country of Birth (MHD)**

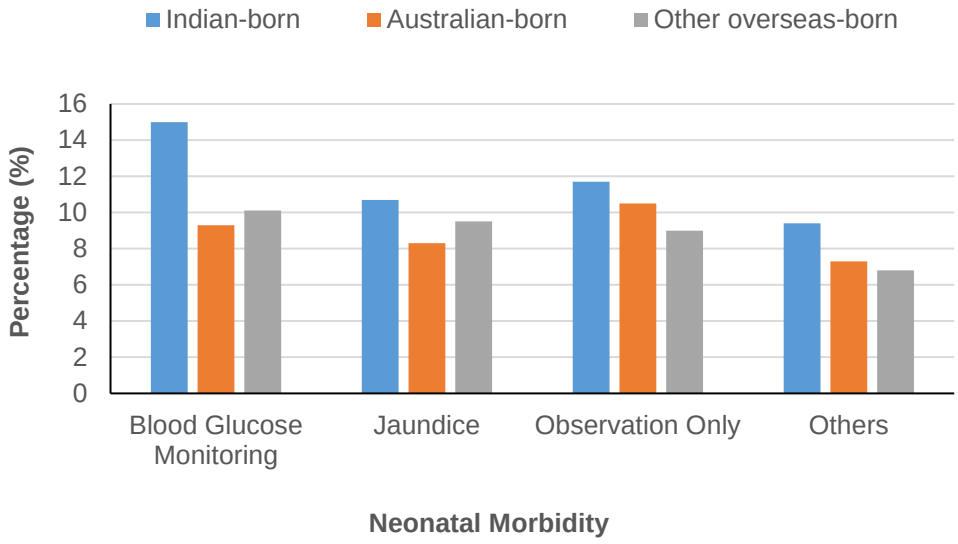


4.3.16 Neonatal Morbidity

Numerous neonatal morbidity conditions were reported in the Monash Health (BOS) data set (as shown in Table 55). A range of most common and routinely collected neonatal morbidity conditions were identified. A Chi-square test for independence was calculated, and yielded a significant association between neonatal morbidity and country of birth, χ^2 (48, n = 3,172) = 100.76, $p < .001$, $V = .13$. A medium Cohen's effect size was observed ($V = .13$). Thus, a medium association was identified between neonatal morbidity and mothers' country of birth.

As illustrated in Figure 40, the largest proportion of blood glucose monitoring was among neonates to Indian-born mothers at 15.0%, with 9.3% for the neonates of Australian-born mothers. The proportion for other overseas-born mothers' neonates was 10.1%. Percentage-wise, the rates of neonates with jaundice, undergoing observation, and others issues, were higher among neonates of Indian-born mothers who gave birth during 2014 (i.e. jaundice-0.7%; observation only-11.7%; others-9.4%), when compared to Australian-born mothers' neonates (i.e. jaundice-8.3%; observation only-10.5%; others-7.3%) and to other overseas-born mothers' neonates (i.e. jaundice – 9.5%; observation only–9.0%; others–6.8%).

***Figure 40*. Neonatal Morbidity and Maternal Country of Birth (MHD)**



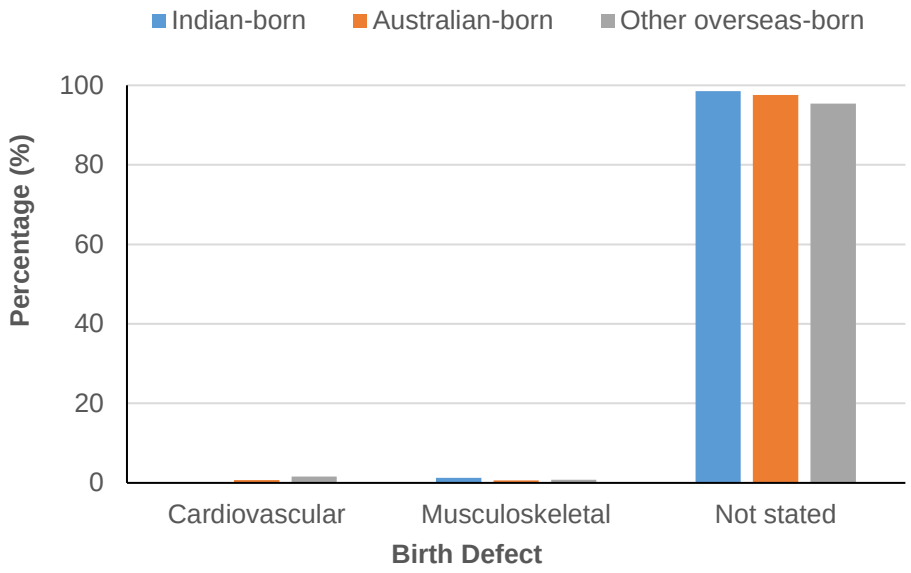
4.3.17 Birth Defects

Birth defects were not stated among the majority of 98.5% of Indian–born mothers, 97.6% of Australian-born mothers and 95.4% other overseas-born mothers. A Chi-square test for independence was calculated, and yielded statistically non-significant association between a birth defect and maternal country of birth, χ^2 (22, n = 3,172) = 33.49, p = .055, V = .07. Further, Cohen's effect size value (V = .07) was consistent with a small effect size. Thus, a minor association was identified between birth defect and mothers' country of birth.

As illustrated in Figure 41, percentage-wise, the musculoskeletal birth defect was largest among Indian-born mothers (1.3%), when compared to 0.6% of Australian-born mothers, and 0.8% of other overseas-born mothers. Percentage-wise, cardiovascular defects were the most common among other overseas-born mothers

(1.6%) when compared to 0.7% of Australian-born mothers and 0% of Indian-born mothers.

***Figure 41*. Birth Defect and Maternal Country of Birth (MHD)**

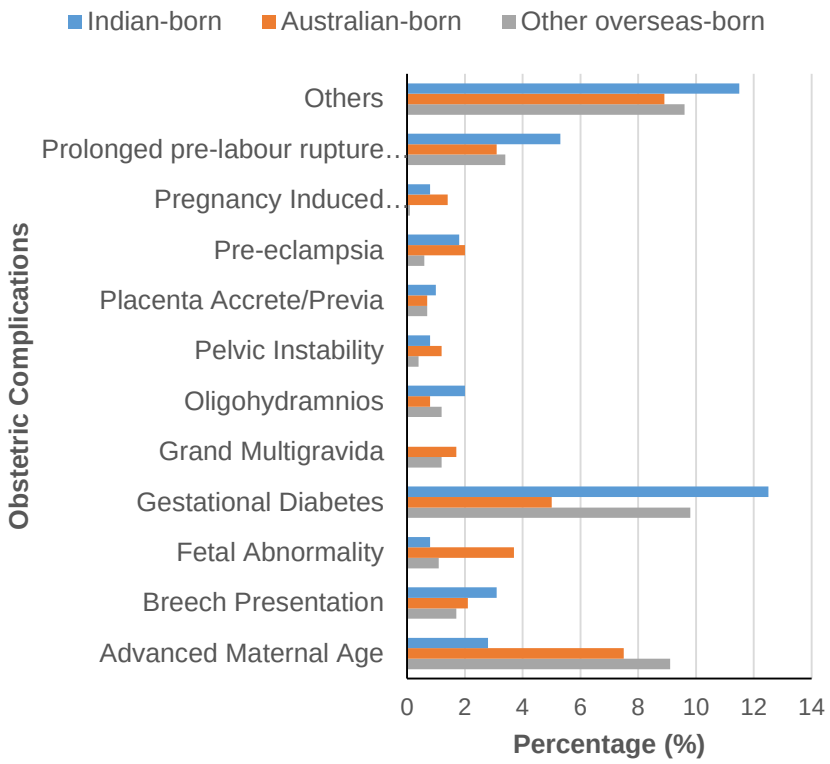


4.3.18 Obstetric Complications

Several obstetric complications were reported in the Monash Health (BOS) Data set (as ahown in Table 57). A Chi-square test for independence was calculated, and yielded a significant association between obstetric complication and country of birth, χ^2 (48, n = 3,172) = 160.55, p < .001, V = .16. A medium Cohen's effect size was observed (V = .16). Thus, a medium association was identified between neonatal morbidity and mothers' country of birth.

As illustrated in Figure 42, a range of the most common and routinely collected obstetric complications were identified. The smallest proportion of mothers who had advanced age during delivery were Indian-born mothers at 2.8%, with 9.1% of other overseas-born mothers also having advanced maternal age during delivery. The proportion of Australian-born mothers with this issue was 7.5%. Percentage-wise, obstetric complications such as breech presentation, gestational diabetes, oligohydramnios, placenta accrete/Previa, prolonged pre-labour rupture of membrane, and others issues, were increased among babies of Indian-born mothers who gave birth during 2014 (i.e. breech presentation–3.1%; gestational diabetes–12.5%; oligohydramnios–2.0%; placenta accrete/Previa–1.0%; prolonged pre-labour rupture of membrane–5.3%; others–11.5%), as compared to babies of Australian-born mothers (i.e. breech presentation–2.1%; gestational diabetes–5.0%; oligohydramnios–0.8%; placenta accrete/Previa–0.7%; prolonged pre-labour rupture of membrane–3.1%; others–8.9%) and to babies of other overseas-born mothers (i.e. breech presentation–1.7%; gestational diabetes–9.8%; oligohydramnios–1.2%; placenta accrete/Previa–0.7%; prolonged pre-labour rupture of membrane–3.4%; others–9.6%). Furthermore, the percentage of fetal abnormality, grand multigravida, pelvic instability, pre-eclampsia, and pregnancy induced hypertension was largest among Australian-born mothers during 2014 (i.e. fetal abnormality–3.7%; grand multigravida–1.7%; pelvic instability–1.2%; pre-eclampsia–2.0%; pregnancy induced hypertension–1.4%), when compared to Indian-born mothers (i.e. fetal abnormality–0.8%; grand multigravida–0%; pelvic instability–0.8%; pre-eclampsia–1.8%; pregnancy induced hypertension–0.8%) and to other overseas-born mothers (i.e. fetal abnormality–1.1%; grand multigravida–1.2%; pelvic instability–0.4%; pre-eclampsia–0.6%; pregnancy induced hypertension–0.1%).

***Figure 42*. Obstetric Complication and Maternal Country of Birth (MHD)**



Findings

Overall, the findings showed that among the 25 variables examined, 18 variables were statistically significant in one or both data sets. Only one variable, Apgar score at 5 minutes evidenced a non-significant association in both data sets. Six variables - plurality, birth status, gestational age, presentation, admission to special care nurseries or neonatal intensive care units, and birth defect – evidenced a non-significant association in the Monash Health (BOS) Data set 2014.

4.4 Synthesis of the Key Findings Across the Two Data Sets

This section synthesizes the key findings/results from both the National Perinatal Data set and the Monash Health (BOS) Data set. When there is data available in both data sets a '✓' appears in the National Perinatal Data set column and a '✓' in the Monash Health (BOS) Data column.

When there is only one data set available (i.e.: only National Perinatal Data set, or only Monash Health (BOS) Data set), a '✓' appears in the column where data is available, and an '✗' where it is not.

Table 8. ***Synthesis of the Key Findings Across the Two Data Sets***

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Maternal age	✓	✓	In both data sets the largest proportion of teenage mothers (younger than 20 years) were Australia-born mothers. Also the largest percentage of mothers aged 25-29 and 30-34 years were Indian-born mothers in both data sets.	In both data sets, maternal age evidenced statistically significant differences with a minor effect size according to Cohen (1988).
Socio-demographic factors	✓	✗	In the NPD Indian-born mothers were most likely to live in above average disadvantaged areas with SEIFA IRSD index between 3-4 decile 24.48% compared to Australian-born mothers 20.39% and other overseas-born mothers 16.95%.	In the NPD socio-economic areas with SEIFA IRSD evidenced a statistically significant association with a minor effect size according to Cohen (1988).
Maternal parity	✓	✓	In both data sets the largest proportion of mothers who did not have a live birth were Indian-born mother's compared to Australian-born and other overseas-born mothers.	In both data sets maternal parity evidenced statistically significant. But the effect size was a minor in NPD, according to Cohen (1988). Whereas the effect size was a medium in MHD (BOS) set, according to Cohen (1988).

Continued…

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data.

Table 8 *Continues*

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Plurality	✓	✓	In both data sets the largest proportion of mother having a singleton birth were Indian-born mothers compared to Australian-born and other overseas–born mothers.	Plurality evidenced statistically significant association in the NPD whereas, non-significant association in MHD (BOS) set. But both data sets had a minor effect size according to Cohen (1988).
Maternal marital status	✓	✓	In both data sets the largest proportion of mothers who were married (including de-facto) were Indian-born mothers.	In both data sets, maternal marital status evidenced statistically significant association, with a minor effect size in NPD whereas, a medium effect size was in MHD (BOS) according to Cohen (1988).
Substance abuse	✓	✓	In both data sets maternal smoking status, Indian-born mothers were least likely to smoke during pregnancy 0.28% compared to 16% of Australian-born mothers and 5.25% of other overseas-born mothers. An interesting fact is the majority of 99.0% of Indian-born mothers did not, abuse substance during pregnancy, compared to 71.4% of Australian-born mothers and 92.3% of other overseas-born mothers.	In the NPD, only maternal smoking status was mentioned. Whereas, in MHD (BOS) set, maternal smoking, alcohol, amphetamines, benzo diazepam, buprenorphine, cannabis others were mentioned. In both data sets, substance abuse evidenced statistically significant association with a medium effect size according to Cohen (1988).

Continued…

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data.

Table 8 *Continues*

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Maternal BMI (kg/m^2)	✓	×	In NPD the smallest percentage of maternal body mass index (kg/m2) 30+ were Indian-born mothers compared to other mothers gave birth in 2012.	In NPD maternal BMI (kg/m^2) evidenced statistically significant association with a minor effect size according to Cohen (1988).
Maternal medical conditions	×	✓	In MHD (BOS) maternal medical conditions like anemia, diabetes mellitus, Vitamin D deficiency, Vitamin B12 deficiency, polycystic ovary and thyroidism, were largest among Indian-born mothers than Australian-born and other overseas-born mothers.	In MHD (BOS) maternal medical conditions evidenced statistically significant association with a medium effect size according to Cohen (1988).
Past history	×	✓	In MHD (BOS) past maternal history such as previous cesarean section was largest among Indian-born mothers. Whereas, history of anxiety, the history of cervical dysplasia and history of depression, was largest among Australian-born mothers.	In MHD (BOS) past history evidenced statistically significant association with a medium effect size according to Cohen (1988).
Duration of pregnancy at first antenatal visit (in weeks)	✓	×	In NPD largest rate of Indian-born mothers had attended antenatal check-ups before 14 weeks of pregnancy, compared to Australian-born mothers and other overseas-born mothers.	In NPD duration of pregnancy at first antenatal visit (in weeks) evidenced statistically significant association with a minor effect size according to Cohen (1988).
Number of antenatal visits	✓	×	In NPD Indian-born mothers had the largest number of 10-13 antenatal visits during pregnancy, compared to other mothers gave birth in Australia in 2012.	In NPD the number of antenatal visits evidenced statistically significant association with a minor effect size according to Cohen (1988).

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Continued…

Table 8 ***Continues***

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Intended place of birth	✓	×	In NPD the hospital was the intended place of birth for most of the Indian-born mothers, compared to other mothers in 2012.	In NPD intended place of birth evidenced statistically significant association with a minor effect size according to Cohen (1988).
Actual place of birth	✓	×	In NPD the largest percentage of mothers whose place of birth was hospital were Indian-born mothers compared to other mothers in 2012.	In NPD actual place of birth evidenced statistically significant association with a minor effect size according to Cohen (1988).
Hospital sector	✓	×	In NPD the largest percentage of mothers who gave birth at the public hospital were Indian-born, compared to other mothers in 2012.	In NPD hospital sector evidenced statistically significant association with a minor effect size according to Cohen (1988).
Method of birth	✓	✓	In both data sets, the smallest percentage of Indian-born mothers had normal vaginal birth. NPD – cesarean section only available. MHD – elective & emergency cesarean section available.	In both data sets, method of birth evidenced statistically significant association with a minor effect size according to Cohen (1988).
Onset of labour	✓	✓	In both data sets, the largest proportion of, mothers who had induced labour were Indian-born mothers compared to other mothers.	In both data sets, onset of labour evidenced statistically significant association with a minor effect size according to Cohen (1988).

Continued…

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data.

Table 8 *Continues*

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Birth status	✓	✓	In both the data sets the percentage of stillbirths was slightly largest among Indian-born mothers compared to Australian-born and other overseas-born mothers.	In both data sets, birth status evidenced a non-significant association.
Presentation	✓	✓	In both the data sets the largest percentage of mothers who had 'other presentations' were Indian-born mothers' compared to Australian-born and other overseas-born mothers.	In NPD presentation evidenced statistically significant association with a minor effect size according to Cohen (1988). Whereas, in MHD (BOS) evidenced a non-significant association.
Gestational age (in weeks)	✓	✓	In NPD the largest percentage of mothers who are at risk for premature birth between 20-27 weeks gestation were Indian-born mothers. In MHD (BOS) the largest percentage of mothers who had birth between 37–41 weeks gestation were other overseas-born.	In NPD – Gestational age starts from 20 weeks to 42 and over and evidenced statistically significant association with a medium effect size. In MHD (BOS) – Gestational age starts from 37 to 42.2 weeks and evidenced a non-significant association.

Continued…

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data.

Table 8 ***Continues***

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Birth weight (in grams)	✓	✓	In NPD percentage-wise, of babies birth weight <1,000 grams and 2,000-2,499 grams, were largest among Indian-born mothers compared to Australian-born and other overseas-born mothers.	In NPD – Birth weight (in grams) starts from lower than 1,000. In MHD (BOS) – Birth weight (in grams) starts from 1,730.
			In MHD (BOS) percentage-wise, of babies birth weight <1,730–1,999 grams and 2,000-2,499 grams, were largest among Indian-born mothers compared to Australian-born and other overseas-born mothers	In NPD birth weight (in grams) evidenced statistically significant association, with a minor effect size and in MHD (BOS) a medium effect size according to Cohen (1988).
Apgar score (at 5 minutes)	✓	✓	In NPD the largest percentage of mothers who had 'Apgar score (0–2) at 5 minutes' were Indian-born mothers' compared to Australian-born and other overseas-born mothers.	In both data sets, Apgar score (at 5 minutes) evidenced a non-significant association.
			In MHD (BOS) the largest percentage of mothers who had 'Apgar score (4–6) at 5 minutes' were Indian-born mothers' compared to Australian-born and other overseas-born mothers.	

Continued…

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data.

Table 8 *Continues*

Variables	NPD 2012	MHD (BOS) 2014	Findings	Comments
Admission to special care nurseries(SCN) or neonatal intensive care units(NICU)	×	✓	In MHD (BOS) the largest percentage of babies' admission to special care nurseries were Indian-born mothers compared to Australian-born and other overseas-born mothers. In MHD (BOS) the largest proportion of mothers who's babies' admission to neonatal intensive care unit were Australian-born mothers compared toIndian-born and other overseas-born mothers.	In MHD (BOS) admission to special care nurseries (SCN) or neonatal intensive care units (NICU) evidenced a non-significant association.
Birth defect	×	✓	In MHD (BOS) musculoskeletal and not stated their birth defect were largest among Indian-born mothers compared to Australian-born and other overseas-born mothers. Whereas, cardiovascular birth defect were largest among other overseas-born mothers compared to Australian-born and Indian-born mothers.	In MHD (BOS) birth defect evidenced a non-significant association.
Neonatal morbidity	×	✓	In MHD (BOS) the largest proportion of blood glucose monitoring, neonates with jaundice, observation and 'others issues' were largest among Indian-born mothers compared to Australian-born and other overseas-born mothers.	In MHD (BOS) neonatal morbidity evidenced statistically significant association with a medium effect size according to Cohen (1988).

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

4.5 Chapter Summary

This chapter has presented the findings of this study. These results address the research questions developed earlier in this study. The National Perinatal Data set and Monash Health (BOS) Data set were divided into different categories including twenty five variables:

Mother: maternal age, SEIFA IRSD, maternal parity, plurality, maternal marital status, maternal smoking status, maternal BMI (kg/m2), pregnancy at first antenatal visit in weeks, number of antenatal visits, intended place of birth, actual place of birth, hospital sector, method of birth, onset of labour, perinatal outcomes.

Babies: presentation, birth status, gestational age (in weeks), birth weight (grams), Apgar score (at 5 minutes), substance abuse, maternal medical conditions, past history, admission to special care nurseries or neonatal intensive care units, neonatal morbidity, birth defect, obstetric complications.

The majority of all mothers were in the 25–34 years age range, with the majority of Indian-born mothers in this range. Indian-born mothers were also more likely to be married, reside in lower socio economic areas, be nonsmokers, and have a BMI <30. This was the case across both the National Perinatal Data set 2012 and the Monash Health (BOS) Data set 2014. Indian-born mothers were more likely to have a history of pregnancies without a live-born baby. The proportion of singleton births was largest among Indian-born mothers, limiting the influence of multiple births as a potential

contributor to low birth weight in this group of mothers. Despite a slightly delayed presentation for the first antenatal visit, Indian-born mothers were more likely to attend all recommended antenatal visits (10–13) when compared to other mothers (refer Appendix 7).

Indian-born mothers reported a very low rate of substance abuse during pregnancy, as compared to Australian-born mothers. Data related to maternal medical conditions was routinely not collected across the Australian states and territories for the national data set and, therefore, this data was not included in the 2012 data set. Tables 7 showed the details of chi-square, significance p value and effect size for each variable. These variables were included in the 2014 hospital (BOS) data set. Among the medical conditions recorded, the largest proportion affecting Indian-born mothers involved anaemia, diabetes mellitus, Vitamin D deficiency, Vitamin B12 deficiency, polycystic ovary syndrome, and thyroidism when compared to other mothers who gave birth in 2014. The percentage of babies admitted to special care nurseries requiring observation, blood glucose monitoring, and experiencing neonatal jaundice was largest among Indian-born mothers when compared to other mothers. Musculoskeletal birth defects were also higher among babies of Indian-born mothers. It is interesting to note that the proportions of mothers suffering from anxiety, depression, asthma, cervical dysplasia and increased BMI >30 were largest among Australian-born mothers (refer Appendix 9).

Indian-born mothers were most likely to give birth in a public hospital, and most likely to have a previous caesarean section when compared to other mothers. Indian-born

mothers were most likely to have an induction of labour and a caesarean section birth, an increased risk of Apgar score (0-2) @ 5 minutes, prematurity (gestational age 20–27 weeks), and low to very low birth weight <1000 grams-1.16% & 2000–2499 grams than other mothers. Indian-born mothers also have a slightly largest risk of stillbirths compared to other mothers. Tables 6 & 7 show the details of chi-square, significance p value and effect size for each variable in both data sets. Most of the variables were statistically significant. However, some non-significant variables expressed a slight statistical difference.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter compares the incidence of adverse perinatal outcomes for Indian-born mothers to other mothers giving birth in Australia. Existing data sets analysed in the conduct of this study included the National Perinatal Data (NPD) set 2012 and Monash Health Birthing Outcomes System (BOS) hospital data set 2014. Simultaneously, findings are discussed with reference to the existing international literature. The general research aim was addressed by investigating the following research questions:

1. What identifiable socio-demographic risk factors, as they relate to obstetrics, are present prior to or during labour/delivery that can predict adverse perinatal outcomes among Indian-born mothers in Australia?
2. How do these outcomes compare to other overseas-born mothers in Australia?

This chapter also discusses the results and limitations of using the pre-existing data and makes recommendations for future obstetric data management.

Specific research into Indian-born mothers' perinatal outcomes has been limited in the Australian context. In general, most published perinatal research examines general comparisons among immigrant mothers, refugee mothers, and Indigenous Australians

(H. G. Dahlen et al., 2013; Gibson-Helm et al., 2014; Graham et al., 2007). Immigrant Indian-born mothers do not share many of the socioeconomic disadvantages experienced by other immigrant groups, particularly refugees. Indian immigrants migrate to Australia as part of the skilled migrant scheme which involves employment in low to middle income work (Deparment of Scocial Services, 2014; A. Moran, 2011). These families are not dependent on government payments to live, they speak some English, and have the support of large Indian communities established over past decades. The findings of the current study are structured under two sections:

Section 1: 'Mothers' including age, sociodemographic factors, parity, plurality, marital status, place of birth, BMI, past history, medical condition, obstetric complications. Maternal characteristics, socioeconomic status indicators, medical history, and obstetric indicators will be examined in order to identify risk factors for adverse perinatal outcomes.

S*ection 2*: 'Babies' including low birth weight, preterm birth, special care & neonatal nurseries admission. Comparisons of the incidence of adverse perinatal outcomes between Indian-born mothers to other overseas-born mothers and Australian-born mothers giving birth in Australia are discussed. Finally, the limitations of the study will be described and the impact these have on study findings related to the incidence of adverse perinatal outcomes for Indian-born mothers when compared to other mothers living and giving birth in Australia.

5.2 Section 1: Mothers

5.2.1 Introduction

There are several important differences in maternal characteristics and perinatal outcomes for Indian-born mothers when compared to other mothers giving birth in Australia in 2012 and at Monash Health in 2014. The literature review demonstrated a lack of population-based studies specifically investigating Indian-born mothers and their adverse perinatal outcomes in Australia. Of the few publications reporting adverse perinatal outcomes for Indian-born mothers in host countries, most investigate mortality risk among babies and obstetric intervention rates (H. G. Dahlen et al., 2013; Gissler et al., 2009). Overall, in other Western countries, the state of perinatal research has been identified as having significant variation between local-born and other overseas-born mothers' pregnancy complications, birth outcomes, and general perinatal health (Gagnon et al., 2009).

Also, studies indicate that most migrant mothers have increased risks for gestational diabetes mellitus compared to mother residents in receiving countries (Gagnon et al., 2011). This also applies to caesarean section birth (Gagnon, Merry, & Haase, 2013; Rio et al., 2010), low birth weight (Castello et al., 2012; M. A. L. Fernandez, Cavanillas, & de Mateo, 2010; M. L. Urquia et al., 2010; Zanconato, Iacovella, Parazzini, Bergamini, & Franchi, 2011), and adverse perinatal health (Gagnon, Zimbeck, & Zeitlin, 2010; Gagnon et al., 2009; Gibson-Helm et al., 2015). A recent study in Australia has confirmed that South Asian Indian-born mothers have a greater risk for late pregnancy stillbirth, low birth weight, and induced labour compared to Australian-

born and New Zealand-born mothers (M. L. Davies-Tuck et al., 2017). Findings from the current study add to and nuance these earlier results.

5.2.2 Maternal Age

In the current study, the data regarding maternal age among Indian-born mothers was identical in both the NPD and MH(BOS) data. The majority of Indian-born mothers gave birth between 24-34 years of age, considered to be the optimal age for childbirth. Indian-born mothers had fewer teenage pregnancies and fewer mothers aged over 35 years compared to Australian-born and other overseas-born mothers (Australian Institute of Health and Welfare, 2016). This finding for Indian-born mothers is not consistent with national trends with increasing numbers of mothers giving birth aged 35 and over (Li, Zeki, Hilder, & Sullivan, 2013) rising to 22% in Australia in 2013 (Australian Institute of Health and Welfare, 2016). Whilst general maternal characteristics have not changed since 2014, there has been a noticeable increase in maternal age (Hilder, Zhichao, et al., 2014).

The trend for mothers being at an older age before having their babies is marked when compared to thirty years ago (W. M. Gilbert, Nesbitt, & Danielsen, 1999; Kenny et al., 2013; Kozuki et al., 2013). Studies in the US and Norway reveal that the birth rates of women 35-39 and 40-45 years have doubled in the last 30 years (Martin et al., 2008). Rates for older aged mothers in the current study was consistent with the national trend, although Indian-born mothers did not contribute to the overall increase in maternal age. It has been suggested that many overseas-born mothers belong to

immigrant groups that require time to establish themselves in their host countries, in order to source employment and housing before starting their family (Craig, 2015).

This finding is significant for migrant groups as an increased maternal age is often associated with increased adverse perinatal outcomes (Andersen et al., 2000; Jacobsson, Ladfors, & Milsom, 2004; Yogev et al., 2010), such as preterm delivery (Blencowe et al., 2012; Kozuki et al., 2013), small for gestational age birth (Kozuki et al., 2013), and increased risks of maternal and obstetric-related complications (Callaway, Lust, & McIntyre, 2005; Gaillard et al., 2013; Hollenbach et al., 2017; Y. Wang et al., 2011; Yogev et al., 2010). In response to the national trend towards older aged mothers, including some groups of immigrant mothers, routine antenatal care must be tailored to manage the increased risk for adverse perinatal outcomes (Tan & Tan, 2013).

Indian-born mothers are having babies at the peak reproductive age for successful delivery. Therefore other risk factors must be investigated to explain why they are at increased risk for adverse perinatal outcomes in Australia (M. L. Davies-Tuck et al., 2017; Hamdi, 2017; Hollenbach et al., 2017; T. C. Liang, Crawford, & Chandra, 2017).

5.2.3 Socio-economic Factors

The current study identified that a majority of Indian-born mothers live in above average socioeconomic areas as defined by SEIFA IRSD (Australian Bureau of Statistics, 2017). The SEIFA IRSD indices indicated that Indian-born mothers were generally living in areas classified as being in the SEIFA IRSD 3-4 decile which is

classified as above average socioeconomically when compared to other mothers living and giving birth in Australia in 2012 (Australian Bureau of Statistics, 2017; George et al., 2012).

Immigrant mothers and refugees are more likely to reside in SEIFA IRSD 1-2 decile (Gibson-Helm et al., 2014), involving below average in ally socioeconomic disadvantaged areas. Socioeconomic status has been reported to be directly associated with increased risks of preterm birth, intra uterine growth retardation (IUGR) (Blumenshine, Egerter, Barclay, Cubbin, & Braveman, 2010; M. S. Kramer, Seguin, Lydon, & Goulet, 2000), increased rates of gestational diabetes and small for gestational age live birth (Joseph, Liston, Dodds, Dahlgren, & Allen, 2007).

In Australia socioeconomic status does not preclude access to maternity services and therefore, does not infer substandard maternity care. Australia provides free maternity care for all mothers who give birth in public hospitals (Roberts, Tracy, & Peat, 2000). It has been suggested that Australian maternity care reflects a ‘one size fits all’ model that may not cater for culturally diverse beliefs pertaining to pregnancy and childbirth (Boxall & Russell, 2009). Immigrant mothers residing in developed countries often experienced worse pregnancy outcomes requiring targeted attention to improve the antenatal care they receive (Bollini, Pampallona, Wanner, & Kupelnick, 2009).

Indian-born mothers in this study do not live in SEIFA IRSD areas of socioeconomic disadvantage. Consequently other risk factors must be investigated to explain why they are increased risk for adverse perinatal outcomes in Australia.

5.2.4 Maternal Parity

Parity is a term used to describe the number of previous pregnancies that have resulted in a viable birth of at least 20 weeks gestation, or weighing at least 400 grams at birth (Hilder, Zhichao, et al., 2014). Findings from the NPD 2012 and Monash Health (BOS) data 2014 were identical for this variable. Null parity (no live births) was found to be most common among Indian-born mothers and may reflect primigravid status (first viable pregnancy). Indian-born mothers were also more likely to have a parity of one (one live birth) compared to other mothers giving birth in Australia.

International studies have reported that null parity and multiparity have been associated with particular types of birth defects (Caton et al., 2009; Lebby, Tan, & Brown, 2010; Reefhuis et al., 2008; J. L. Zhu, Basso, Obel, Bille, & Olsen, 2006) (Agopian, Marengo, & Mitchell, 2009; Cragan & Gilboa, 2009; Oddsberg, Jia, Nilsson, Ye, & Lagergren, 2008; Werler, Bosco, & Shapira, 2009; Yang, Carmichael, Harris, & Shaw, 2006). Null parity is often associated with recurrent spontaneous abortion, which in some cases is an indicator for genetically inherited fetal anomalies. Spacing of pregnancies has also been identified as an important risk factor for pregnancy loss. In developing countries planned pregnancies allowing adequate time for the mother to recover from the previous pregnancy, or pregnancy loss, has been found to reduce recurrence of adverse perinatal outcomes (Tschann & Soon, 2015). Indian-born mothers having a parity of one or two is considered to be a protective factor against risk for adverse perinatal outcomes (De Graaff et al., 2017; Reddy et al., 2017).

5.2.5 Plurality

The incidence of singleton birth was greater among Indian-born mothers and other overseas-born mothers compared to Australian-born mothers. Both the National Perinatal Data 2012 and Monash Health (BOS) Data 2014 were consistent relative to this variable. This result is congruent with those reported by Dahlen et al., which demonstrated that Indian-born mothers presented as low risk primipara's with a singleton pregnancy. However, they were at greatest risk for induced labour, instrumental delivery and caesarean section birth (H. G. Dahlen et al., 2013). Indian-born mothers are less likely than Australian-born mothers to have a multiple pregnancy. Other risk factors, need to be explored to explain why healthy young low risk Indian-born mothers at increased risk for adverse perinatal outcomes.

5.2.6 Marital Status

Indian-born mothers in this study were more likely to be married (97.9% including de-facto) compared to Australian-born and other overseas-born mothers. This finding was identical in both the National Perinatal Data 2012 and Monash Health (BOS) Data 2014. It is suggested that strong psychological and cultural belief systems are responsible for ensuring that pregnancy and birth occurs within marriage, whereas pregnancy outside marriage brings social stigma on the woman and her family (Corbett & Callister, 2012; Pradhan & Ram, 2010).

Raatikainen et al. reported that marital status is a protective factor for adverse perinatal outcomes. Marital status protects against adverse social risk factors, increased risks of low birth weight, preterm birth, and small for gestational age babies

(Raatikainen, Heiskanen, & Heinonen, 2005). The majority of Indian-born mothers giving birth in Australia are socioeconomically advantaged through marriage. In the absence of increased risk associated with socioeconomic disadvantage, other risk factors need to be identified that explain why Indian-born mothers are at increased risk for adverse perinatal outcomes.

5.2.7 Maternal Smoking Status and Substance Abuse

In Australia nationally, maternal smoking is declining: 12.5% of women smoked during pregnancy in 2012, compared with 13.2% in 2011 (Hilder, Zhichao, et al., 2014). In the current study, Indian-born mothers were least likely to smoke during pregnancy compared with Australian and other overseas born mothers. Data from the NPD and the Monash Health (BOS) Data concurred with this finding.

Maternal Smoking Status: Maternal smoking during pregnancy has been associated with unexplained stillbirth (V. Flenady, Koopmans, et al., 2011), infant mortality (Hogberg & Cnattingius, 2007; Wisborg, Kesmodel, Henriksen, Olsen, & Secher, 2002; Yerushalmy, 2014), low birth weight, increased risk of miscarriage, ectopic pregnancy, preterm birth and placental abruption (Israel T et al., 2014; K. W. Lee et al., 2015; Pereira, Da Mata, Figueiredo, de Andrade, & Pereira, 2017). In Australia, the prevalence of smoking is largest for Indigenous mothers than for others (V. Flenady, Koopmans, et al., 2011). Previous research has also shown that smokeless tobacco impacts pregnancy, with decreasing gestational age at birth and low birth weight independent of gestational age (P. C. Gupta & Sreevidya, 2004). Indian-born mothers are non-smokers and yet have low birth weight babies. Researchers need to

look elsewhere to identify risk factors that contribute the the increased risk Indain-born mothers have for having a baby of low low birth weight.

Substance Abuse: The majority of Indian-born mothers (99%) did not abuse substances during pregnancy. Studies conducted by Kennare et al. in South Australia demonstrate that women abusing substances during pregnancy had increased risks of antepartum haemorrhage and placental abruption, and increased risks for poor perinatal outcomes, such as preterm birth, small for gestational age, congenital abnormalities, admission to neonatal intensive care unit, stillbirth, neonatal death (Kennare, Heard, & Chan, 2005; Maeda et al., 2014), and low birth weight (Baldacchino et al., 2014; Conner et al., 2016).

Studies show that, despite regular antenatal care, mothers abusing substances during pregnancy are at significant risk of adverse obstetric and perinatal outcomes (Pinto et al., 2010). Findings from the Monash Health (BOS) Data set 2014 show that Indian-born mothers were not abusing any substance during pregnancy. Other risk factors need to be examined to explain why Indian-born mothers are at increased risk for adverse birth outcomes such as low birth weight, preterm babies, and stillbirth (M. L. Davies-Tuck et al., 2017; Reddy et al., 2017).

5.2.8 Maternal BMI (Kg/m^2)

The number of pregnant women with a body mass index 30+ kg/m^2 was fewest among Indian-born mothers compared to other mothers giving birth in Australia. BMI index was only recorded in the national data set, with BMI data collected from Victoria,

Queensland, South Australia and Tasmania, and partially collected from Western Australia and the Australian Capital Territory (Hilder, Zhichao, et al., 2014). Small BMI increases are expected in a healthy pregnancy, however a mother who is overweight prepregnancy is at higher risk for becoming obese during pregnancy and prior to giving birth. Overweight or obese mothers face an increased risk for caesarean delivery and small for gestational age babies (Kansu-Celik, Kisa Karakaya, Guzel, Tasci, & Erkaya, 2017; Wilkins, Alabaster, & Gunderson, 2017).

Maternal BMI related to Indian-born mothers has historically been concerned with mothers being underweight rather than being overweight. In a recent study comparing weight gain during pregnancy (using Institute of Medicine Guidelines) among Asian Indians across different body mass index (BMI) categories, mothers who gained less weight than recommended had a low risk for caesarean section an increased (but statistically insignificant) risk for low birth weight and preterm birth (Bhavadharini et al., 2017). The majority of Indian-born mothers are of healthy weight throughout pregnancy, but remain at increased risk for adverse birth outcomes in Australia. Other risk factors must be sought that explain why this risk is increased for these mothers.

5.2.9 Duration of Pregnancy at First Antenatal Visit (in weeks)

Antenatal care guidelines recommend that the first antenatal visit should occur in the first trimester (before 14 weeks gestation). Whilst WHO recommends that expectant mothers receive a total number of at least four antenatal visits during pregnancy (AIHW, 2015), Australian antenatal guidelines recommend 10–12 visits to a qualified maternity care professional. More than half of the Indian-born mothers attended their

first antenatal visit before 14 weeks gestation and went on to attend all subsequent appointments.

It is suggested that Indian-born mothers value maternity care provided by qualified professionals, in order to achieve a safe delivery in their host country. Other immigrant mothers may have a different belief system. Gagnan et al. report that immigrant mothers may not be receiving the antenatal care they need (Gagnon et al., 2010). Studies have shown that migrants tend to use health services less in countries such as Canada (Blais & Maiga, 1999; Scheppers et al., 2006) and the UK (Lakhani, 2008). A European study found that pregnant women who did not access available maternal care as per the WHO recommendation were identified to be of foreign origin (Delvaux, Buekens, Godin, & Boutsen, 2001).

Australian studies reveal a high proportion of women from developing countries resident in New South Wales presented to antenatal clinics late in their pregnancies (Trinh & Rubin, 2006). Thirteen percent of pregnant women, around 1 in 8 women, did not begin antenatal care until 20 weeks gestation (AIHW, 2015). Also the proportion of mothers who received antenatal care in the first trimester of pregnancy decreased, from 69% in 2010 to 62% in 2013 (AIHW, 2015). This decrease may be an indicator that the public maternity system is stretched to capacity, with women needing to book ahead and wait for antenatal appointments.

Studies reporting the experience of womens' maternity care indicate that major concerns relate to length of waiting times for antenatal appointments, provision of

enough information and explanations at antenatal visits, a lack of continuity of care (Hildingsson, Waldenström, & Rådestad, 2002; Homer, Davis, Cooke, & Barclay, 2002), and a lack of staff attention to individual concerns (Aune, Dahlberg, & Ingebrigtsen, 2012; S. J. Brown & Bruinsma, 2006; Novick, 2009; Redshaw & Heikkilä, 2010). Women are more likely to feel safe during the stress and pain of labour if they are being cared for by a known maternity care professional rather than a stranger (Aune et al., 2012; J. M. Green, Renfrew, & Curtis, 2000; Leap, Sandall, Buckland, & Huber, 2010; Rowe, Fitzpatrick, Hollowell, & Kurinczuk, 2012; Jan Walker & Psychol, 2000). The comparison between this study and the literature in the context of Indian-born mothers remains limited, as there has been no study reported to date describing Indian mothers experience of Australian maternity services. Despite attending the first antenatal visit in the first trimester of pregnancy as recommended, Indian-born mothers are at increased risk for adverse perinatal outcomes.

5.2.10 Number of Antenatal Visits

Australian antenatal care guidelines recommend having the first antenatal visit within the first 10 weeks of pregnancy and 7-10 follow-up antenatal visits (Australian Health Ministers' Advisory Council, 2012). Indian-born mothers attended 10-13 antenatal visits during pregnancy, recording the highest rate of attendance when compared to Australian-born mothers and other overseas-born mothers.

It is suggested that migrant mothers' less than optimal attendance at antenatal appointments may be due to unfamiliarity with the points of access for the maternity care system Australia (Women's & Health, 2010). In Australia, pregnancy is first

confirmed by a general medical practitioner before being referred to a local maternity service (S. J. Brown, Sutherland, Gunn, & Yelland, 2014; Lucas, Charlton, Brown, Brock, & Cummins, 2015). This is not a situation that is familiar to migrated populations, where pregnancy is not required to be medically confirmed before approaching the maternity service (Guinean). The psychological and cultural beliefs surrounding pregnancy and childbirth held by immigrant mothers giving birth in Australia is an area that requires greater recognition in order to achieve increased participation in antenatal care (A. E. Brown, Middleton, Fereday, & Pincombe, 2016; Phiri, Dietsch, & Bonner, 2010).

Regular antenatal appointments with a qualified maternity care professional attendance is considered a protective factor against adverse perinatal outcomes. Despite attending the recommended number of antenatal visits (10-13 visits), Indian-born mothers remain at an increased risk for adverse perinatal outcomes.

5.2.11 Place of Birth

In Australia, almost all births occur in hospitals in conventional birth suite settings, (Hilder, Zhichao, et al., 2014). However, Australian-born mothers are more likely to give birth in a non-conventional settings such as birth centres. Indian-born mothers and other overseas-born mothers delivered their babies in hospital birth suites, with immediate access to modern safety equipment, medical and midwifery expertise, and operating room facilities should they be needed.

The modern practice of midwifery advocates that pregnant women benefit from being able to participate in decision making and planning related to the birth (Enkin et al., 2001; Gibbins & Thomson, 2001; Hauck, Fenwick, Downie, & Butt, 2007). However, it is well known that giving birth in a hospital maternity unit decreases the amount of control the mother may have (Goodman, Mackey, & Tavakoli, 2004; Hardin & Buckner, 2004).

Findings from the current study show that low risk Indian-born mothers planned a hospital birth, resulting in increased rates of induced labour, increased rates of obstetric intervention, and caesarean section delivery (H. G. Dahlen et al., 2013). In contrast, mothers with low risk pregnancies who planned their birth at home had consistently lower intervention rates at the time of labour and birth (Brocklehurst et al., 2011; D. Davis et al., 2011; Hutton, Reitsma, & Kaufman, 2010; Janssen et al., 2002; Janssen et al., 2009; S. Miller & Skinner, 2012; Van Der Hulst, Van Teijlingen, Bonsel, Eskes, & Bleker, 2004).

Migrant mothers often lack family and social support and are hampered by limited English language capability (Refugee Council of Australia). These same mothers experience reduced satisfaction with hospital birth relating to poor communication of expectations, psychological and cultural preferences (Tsolidis, 1995; Y. O. Wells & Dietsch, 2014). Bilingual health workers are recommended to be available for all non-English speaking immigrant women admitted in labour to the hospital (Abebe, 2010; Ulrey & Amason, 2001).

Indian-born mothers give birth in hospitals in Australia with immediate access to quality medical and emergency care. Place of birth cannot be considered a risk factor for adverse perinatal outcomes.

5.2.12 Medical Intervention during Labour

Indian-born mothers had a higher rate of induced labour and caesarean section delivery or instrumental birth than in other mothers giving birth in Australia (Anderson et al., 2013; H. Dahlen & Homer, 2008; H. G. Dahlen et al., 2013; M. L. Davies-Tuck et al., 2017; Reddy et al., 2017). Induction of labour is currently practised for medical indications, such as prolonged pregnancy and prolonged rupture of membranes (Walsh et al., 2011), and is performed in approximately 20% of low risk pregnancies (Gissler et al., 2010). Increased numbers of Indian-born mothers had a forceps or vacuum extraction birth (Hilder, Zhichao, et al., 2014), which was double the number of Australian-born and other overseas-born mothers.

Caesarean section birth was more frequent among Indian-born mothers than Australian-born and other overseas-born mothers. The specific reasons for this cannot be deduced from the aggregated national data set. Rates of emergency caesarean section birth are increased in certain migrant groups e.g. Indian, African and Latin American (Gagnon et al., 2013; Malin & Gissler, 2009; Merry, Small, Blondel, & Gagnon, 2013; Merten, Wyss, & Ackermann-Liebrich, 2007; Rio et al., 2010; Vangen, Stoltenberg, Skrondal, Magnus, & Stray-Pedersen, 2000). These increased rates are unexplained, and do not reflect national trends (Hilder, Zhichao, et al., 2014). Other overseas-born mothers had the highest rates for spontaneous onset of labour.

Spontaneous onset of labour is associated with reduced rates of intervention (Hilder, Zhichao, et al., 2014).

Indian-born mothers are at increased risk for intervention in labour and delivery. The link between higher rate of intervention and increased incidence of adverse perinatal outcomes requires further research.

5.2.13 Maternal Medical Condition

The variable related to maternal medical conditions was not included in the aggregated National Perinatal Data set. The Monash data set provided limited information related to medical conditions. The most common maternal medical conditions recorded included iron deficiency anaemia, anxiety, asthma, diabetes mellitus, thyroidism, increased BMI, vitamin D deficiency, vitamin B & B12 deficiency, and polycystic ovary.

This current study reveals that the largest proportion of Indian-born mothers were found to have iron deficiency anaemia, diabetes mellitus, vitamin D and vitamin B & B12 deficiency, thyroidism and polycystic ovary when compared to Australian-born and other overseas-born mothers. Findings show that common medical conditions such as anxiety, asthma, and increased BMI were most prevalent among Australian-born mothers compared to other overseas-born mothers and Indian-born mothers. The common medical conditions in pregnancy in an Australian setting are examined individually below:

Anaemia: The current study's findings show that Indian-born mothers were most likely to suffer from anaemia. Iron deficiency anaemia is dietary related and avoidable. Iron deficiency anaemia is associated with low birth weight babies and preterm delivery. These findings are supported by previous research in Australia by Fernandez et al. who reported that Indian-born mothers are more prone to iron deficiency anaemia (R. Fernandez et al., 2015). Thus, prevention and treatment of maternal anaemia is important for the prevention of adverse birth outcomes (Brabin, Hakimi, & Pelletier, 2001; Cuervo & Mahomed, 2001).

Gestational Diabetes Mellitus: Gestational diabetes mellitus is a more common maternal medical condition among India-born mothers in Australia (Carolan et al., 2010). South Asian mothers are more prone to pre-existing diabetes and gestational diabetes mellitus than Australia-born and New Zealand-born mothers (M. L. Davies-Tuck et al., 2017). These findings are consistent with the international trends for increased rates of gestational diabetes mellitus among mothers migrating from low to high income countries including mothers of Indian and Arab ethnicity (Ben-Haroush, Yogev, & Hod, 2004; Dempsey et al., 2004; Shaat et al., 2004; Weijers, Bekedam, & Oosting, 1998). A variety of contributing factors have been proposed to explain why migrant mothers are at greatest risk for gestational diabetes mellitus. Life style changes associated with migration to a foreign host country, including alteration to the staple diet and reduction in daily exercise, result in rapid weight gain (Fitzgerald et al., 2006; Goel, McCarthy, Phillips, & Wee, 2004; B. N. Kumar et al., 2009; Saleh, Amanatidis, & Samman, 2002).

Vitamin D deficiency : Vitamin D is important for placental function and necessary for optimal fetal growth and development (Hollis & Wagner, 2006; Thorne-Lyman & Fawzi, 2012; Wei, Qi, Luo, & Fraser, 2013). Indian-born mothers have increased rates of vitamin D deficiency. Vitamin D deficiency is routinely managed using oral vitamin D supplements for cases where serum 25-hydroxyvitamin D3 concentrations are below 20-40 nmol/L (Mason & Diamond, 2001). Prepregnancy intervention is required to address this avoidable vitamin deficiency by increasing foods rich in vitamin D in the regular diet.

Vitamin B12 deficiency: Vitamin B12 is essential for normal growth and development of the fetus during pregnancy (Bhate et al., 2008; Krishnaveni et al., 2009; Refsum, 2001; Yajnik et al., 2008). South Asian mothers have an insufficient dietary B12 intake (Gammon, von Hurst, Coad, Kruger, & Stonehouse, 2012) associated with vegetarianism or low meat eating practices (Gammon et al., 2012), combined with higher prices for food containing B12 (Wilson et al., 2013). Approximately 40 -75% of Indian-born mothers of childbearing age are affected (Krishnaveni et al., 2009; Samuel et al., 2013; Yajnik et al., 2008). This is supported by a New Zealand study that found that B12 deficiency is common in South Asian childbearing age mothers in Auckland (Mearns, Koziol-McLain, Obolonkin, & Rush, 2014). Cultural change is required to address this avoidable health condition in pregnancy. Women of childbearing age, who wish to have children in the future, need to be encouraged to eat food containing vitamin B12, rather than culturally preferred food such as rice or tofu.

Thyroidism: Hypothyroidism has a profound impact on pregnancy. Indian-born mothers are at increased risk for developing hypothyroidism resulting in maternal thyroid dysfunction and adverse birth outcomes (Karakosta et al., 2012). Hyperthyroidism has been associated with stillbirth, miscarriages, preterm delivery and intrauterine growth restriction or low birth weight babies (De Groot et al., 2012; Weetman, 2000). Hypothyroidism has also been associated with risks of pregnancy induced hypertension, spontaneous abortion, postpartum haemorrhage, and fetal death (Ashoor, Maiz, Rotas, Kametas, & Nicolaides, 2010; Casey et al., 2005; Karakosta et al., 2012; Norstedt Wikner, Skjöldebrand Sparre, Stiller, Källén, & Asker, 2008; Schneuer, Nassar, Tasevski, Morris, & Roberts, 2012). Adverse birth outcomes can be prevented by early detection and management of hypothyroidism (Matalon, Sheiner, Levy, Mazor, & Wiznitzer, 2006; Negro et al., 2010).

Polycystic Ovary: Polycystic ovarian syndrome affects Indian-born mothers at a greater rate than other women, the cause for which is unexplained (Nair et al., 2012). Polycystic ovarian syndrome (PCOS) is the most common endocrine disorder occurring in the reproductive years (Goodarzi, Dumesic, Chazenbalk, & Azziz, 2011; Katherine Michelmore et al., 2001). Untreated PCOS is associated with decreased fertility and hormonal dysfunction that may disrupt an early pregnancy (Palomba, Santagni, Falbo, & La Sala, 2015) resulting in recurrent early pregnancy loss.

Indian-born mothers are at increased risk for iron deficiency anaemia, vitamin B and B12 deficiency, gestational diabetes mellitus, hypothyroidism and polycystic ovarian syndrome. Iron deficiency anaemia, vitamin B and B12 deficiency, and hypothyroidism

are dietary related conditions that are avoidable when living in a Western country with a medium to high standard of living. Cultural change is required to encourage Indian-born mothers of childbearing age to include iron, iodine, and vitamin B rich foods in their diets. Early diagnosis and medical management is recommended to treat established disease to reduce the risk for adverse perinatal outcomes.

5.2.14 Past History

A previous caesarean section delivery was higher among Indian-born mothers compared to other mothers. Conversley a history of anxiety, depression, and cervical dysplasia was higher among Australian-born mothers.

Australian obstetric guidelines recommend elective caesarean section following a previous caesarean delivery, to avoid emergency life threatening complications related to the scar on the uterine wall. Placental acretia occurs in cases where the placenta has implanted into the old scar tissue, leading to failure of the placenta to separate following birth, resulting in profuse haemorrhage. Emergency life saving surgery involves total removal of the uterus (Rahman et al., 2008). Consequently there are higher rates of caesarean section delivery in women who required a caesarean section in their first delivery, continuing to add to the overall Australian caesarean section rate of 33% (Australian Institute of Health and Welfare, 2017). Anxiety and depression during pregnancy have been associated with adverse perinatal outcomes such as preterm or low birth weight (Grigoriadis et al., 2013; Grote et al., 2010; KF Michelmore, Balen, Dunger, & Vessey, 2000) and recurrent miscarriage (Nkansah-Amankra, Luchok, Hussey, Watkins, & Liu, 2010; Sugiura-Ogasawara et al., 2002;

Wadhwa, Culhane, Rauh, & Barve, 2001). However, most pregnant mothers will experience some level of anxiety without affecting pregnancy outcomes (American Psychiatric Association, 2013).

In Australia, Indian-born mothers whose first baby was delivered by caesarean section have elective caesarean deliveries for subsequent births. Caesarian section birth is promoted as a safe method of delivery and, as such, is a protective factor. Despite this, Indian-born mothers have increased risk for adverse birth outcomes.

5.2.15 Obstetric Complications

Obstetric complications were reported in the Monash Health 2014 (BOS) Data set. This data was not supplied in the National Perinatal Data set 2012. Indian-born mothers had increased rates of obstetric complications including oligohydramnios, placenta accrete, placenta previa, and prolonged pre-rupture of membranes compared to other mothers who gave birth during 2014 at Monash Health.

Placenta previs is an obstertric complication of pregnancy for which Caesarean section is recommended for delivery (Cresswell, Ronsmans, Calvert, & Filippi, 2013; Silver, 2015). Babies born from pregnancies with placenta previa have a significantly higher risk for emergency birth preterm, having low Apgar score, being transferred to neonatal intensive care, and death (Norgaard, Pinborg, Lidegaard, & Bergholt, 2012). Older maternal age, multiparity, and previous caesarean section have all been associated with placenta previa (Fujii, Matsuoka, Bergel, van der Poel, & Okai, 2010; Romundstad et al., 2006; T. Rosenberg, Pariente, Sergienko, Wiznitzer, & Sheiner,

2011). As previously described, placental acreta is a complication of labour following the birth of the infant. Poor maternal outcomes are associated with this condition with the baby unaffected.

Indian-born mothers face an increased risk for obstetric complications, despite attending an optimal number of antenatal appointments and giving birth in a maternity hospital staffed by maternity care experts. It is apparent that other as yet unknown risk factors are contributing to this increased risk.

5.3 Section 2: Babies

5.3.1 Introduction

The Monash Health (BOS) Data includes 3,172 births; representing all births that occurred across the three Monash Health sites in 2014. Of the three sited, Casey hospital provides primary and secondary level maternity care. Women who develop complications during pregnancy are transferred to either Dandenong hospital or Monash Medical Centre (MMC) Clayton, dependent upon the level of care required and the bed availability. Dandenong hospital provides primary and secondary level maternity care. Women who develop complications during pregnancy requiring tertiary level specialist medical care are transferred to Monash Medical Centre Clayton. Maternity bookings and transfers into Monash Medical Center Clayton are prioritised according to the level of specialist care required. Unit level data for each of the variables was available, thus enabling a more sophisticated inferential statistical analysis to be performed. Despite the availability of free maternity services and

systemized protocol-driven maternity care, Indian-born mothers were still at increased risk for adverse birth outcomes in Australia.

5.3.2 Birth Outcomes

Stillbirth, birth defects and presentation of the baby are discussed in this section of the discussion. Birth outcome findings involving the National Perinatal Data set 2012 and the Monash Health (BOS) 2014 data set are consistent regarding the proportions of babies of Indian-born mothers affected by adverse perinatal outcomes. There was no difference in birth status among Indian-born mothers, Australian-born mothers and other overseas-born mothers. The incidence of live births and still births reflect national trends involving 7.4 stillbirths per 1,000 births in Australia in 2012 (Hilder, Zhichao, et al., 2014). A slight increase in percentage of stillbirth for Indian-born mothers who gave birth during 2014 at Monash Health was observed.

Stillbirth: South Asian-born mothers (Indian, Sri Lanka, Bangladesh, Pakistan) were more than twice as likely to have a late-pregnancy antepartum stillbirth than Australian-born or Asian-born mothers attending the same pregnancy care service (Drysdale et al., 2012). These findings are supported by European and US studies reporting that mothers of South Asian origin have an increased risk of stillbirth (Gagnon et al., 2009; Gissler et al., 2009; Ravelli et al., 2010). Region of birth has been listed as a risk factor for stillbirth for South Asian mothers in the absence of other indicators (M. L. Davies-Tuck et al., 2017). Some migrant mothers have significantly different perinatal outcomes to non-migrant mothers however no causality has been identified between migration and increased risk for stillbirth (Gagnon et al., 2009;

Hogue & Silver, 2011; Ravelli et al., 2010; Sorbye, Stoltenberg, Sundby, Daltveit, & Vangen, 2014).

South Asian Indian-born mothers in the UK (Gardosi, Madurasinghe, Williams, Malik, & Francis, 2013), Norway (Sorbye et al., 2014), the Netherlands (Ravelli et al., 2010), Sweden (Ekeus, Cnattingius, Essen, & Hjern, 2011), Singapore (Viegas et al., 1995), and Australia (De Graaff et al., 2017; Drysdale et al., 2012) are more likely to have a stillbirth than other mothers. Adding complexity to this situation, increased stillbirth rates among South Asian mothers were higher among UK-born South Asian mothers compared to newly migrated South Asian-born mothers (Balchin, Whittaker, Patel, Lamont, & Steer, 2007).

It has been proposed that differences in placental aging and associated placental dysfunction may explain why Indian-born mothers have an increased risk for stillbirth in late pregnancy. There is emerging evidence that implicates maternal ethnicity as factor associated with premature placental aging (R. Smith et al., 2013). Indian-born mothers also have a significantly smaller placental surface area, weight and volume than other mothers of Asian descent (Sivarao et al., 2002).

Asian Indian ethnicity is a risk for placental dysfunction in late pregnancy which may be associated with a minor non-significant increased risk for stillbirth.

Presentation of baby: Presentation at birth is defined as, “the presenting part of the fetus at birth” (Hilder, Zhichao, et al., 2014). Indian-born mothers who gave birth in 2012 were more likely to have a shoulder or brow presentation than other mothers.

Elective casearian section is recommended obstretric practice in these situations (Goffinet et al., 2006). Although, there were no statistically significance findings in this section, Australian-born mothers had the highest incidence of breech presentations for which elective caesarean section is prescribed.

Birth defects: Data on the incidence of birth defects is incomplete in the Monash Health (BOS) Data and absent in the national data set. This absence may be because diagnosis of birth defects takes time reliant on extensive testing. Whilst rare babies with a musculoskeletal birth defect were most likely to be born to Indian-born mothers. Australian-born mothers were at highest risk for babies with cardiovascular birth defect. There is no data on neural tube defects for which folic acid supplementation has been added to bread flour nationally (Botto et al., 2005; Hernandez-Diaz, Werler, Walker, & Mitchell, 2000).

5.3.2.1 Prematurity

Indian-born mothers are at an increased risk for preterm birth between 20-27 weeks gestation compared to Australian-born and other overseas-born mothers. Most Australian babies are born at term and less than 1 in 10 are preterm (AIHW, 2015).

In Australia in 2012, 8.5% of all babies were born preterm, the majority at a gestational age of 32-36 weeks (Hilder, Zhichao, et al., 2014). Unfortunately, unit level data from Monash Health (BOS) data was only supplied for gestational age at term 37 weeks to 42.2 weeks. No data pertaining to Indian-born mothers risk for very preterm deliveries 20 – 27 weeks gestation was included. Other overseas-born mothers were most likely to give birth at term 37-41 weeks of gestation. This finding is in contrast to that of a

Canadian study suggesting that increased risk of preterm delivery was associated with the duration of migrant residency in the country (M. Urquia et al., 2010; M. L. Urquia, O'Campo, & Heaman, 2012).

Proposed causation for preterm birth has implicated low socioeconomic factors, genetic predisposition, Asian ethnicity, and biological factors (M. R. Kramer & Hogue, 2009; Menon et al., 2009; Varner & Esplin, 2005). Similarly Asian-born mothers have a higher incidence of small for gestational age babies compared to other mothers (MacDonald, McCarthy, & Walker, 2015). Small for gestational age describes babies who have failed to gain weight in the later weeks of pregnancy in response to placental insufficiency (Krishna & Bhalerao, 2011). The possibility that placental dysfunction may be involved in both very preterm birth 20–27 weeks and small for gestational age babies needs to be explored.

It has been suggested that the optimal delivery time for South Asian mothers is 38-39 weeks, before complications associated with placental aging begin to impact the wellbeing of the fetus (Balchin, Whittaker, Lamont, & Steer, 2011; Balchin et al., 2007; Ravelli et al., 2010). Similarly 38-39 week delivery is recommended for African-Caribbean mothers to avoid late pregnancy risk for fetal compromise (Kazemier, Ravelli, Groot, & Mol, 2014).

Indian-born mothers are at increased risk for very preterm delivery 20–27 weeks and babies born small for gestational age. Risk factors associated with these increased risks are poorly understood. A multitude of maternal factors are implicated but this

study was unable to identify a risk in common. Further research is required to investigate the association between Indian-born mothers, very pre term birth 20–27 weeks and babies who are born small for gestational age.

5.3.2.2 Low Birth Weight (in grams)

Indian-born mothers are at increased risk for extreme low birth weight babies (less than 1,000 grams and low birth weight 2,000–2,499 grams) than Australian-born and other overseas-born mothers in 2012. Extreme low birth weight (less than 1,000 grams is a complication of preterm birth 20–27 weeks. Low birth weight (2,000–2,499 grams) may include small healthy babies, at the top of this weight range commonly observed for Indain-born mothers, or babies born small for gestational age. Findings were consistent for both data sets although Monash Health (BOS) data used a different measure (<1,730 grams) for low birth weight to that used by the national data set (<2,499 grams). Significantly, there was no difference in birth weight among Indian–born mothers between 2012 and 2014, indicating that the problem persists. The incidence of low birth weight in live born babies in Australia has slightly increased in the past decade (Hilder, Zhichao, et al., 2014).

Dahlen et al. measured Indain-born mothers risk for low birth weight to be twice that of Australian-born mothers (H. G. Dahlen et al., 2013). Alarmingly, India accounts for 40% of low birth weight cases in the developing world (L. Liu et al., 2012; Vogel, Lee, & Souza, 2014). Indian-born mothers have a similar increased risk for low birth weight and babies born small for gestational age when living in US and Canada compared to Caucasians and African Americans (Alexander et al., 2007). Placental monitoring

including measurement of placental diameter and placental volume, is recommended in late pregnancy in addition to other routine fetal surveillance for women where suboptimal fetal growth is suspected (Ramdurg, 2015).

This current study was unable to identify the proportion of healthy small babies whose weight was in the higher ranges of the low birth weight <2,499 grams. The inclusion of small healthy babies may be responsible for the very high incidence of low birth weight reported for Indian-born mothers. Low birth weight is classified as an adverse perinatal outcome but this would not be the case for small healthy babies at the top of this weight range. It is also important to differentiate the incidence of healthy babies of low birth weight versus sick babies of low birth weight.

Further research is required to identify why Indian-born mothers have an increased incidence of low birth weight compared to other mothers. To better understand the impact that an increased incidence of low birth weight has for Indian-born mothers, it is necessary to differentiate between healthy babies of low birth weight compared to sick babies of low birth weight.

5.3.2.3 Apgar Score (at 5 minutes)

The Apgar score is calculated at 1 minute following birth and repeated again at 5 minutes following the birth of the baby. The Apgar score is a measure of the physical condition of the newborn and newborn adaptation to extrauterine life. An Apgar score 0-2 at 5 minutes is a life threatening situation, whilst an Apgar score of <7 is an indication that active resuscitation is required.

More babies of Indian-born mothers had a very low Apgar score at 5 minutes of 0–2 than babies of Australian-born and other overseas-born mothers who gave birth in 2012. Similarly, Indian-born mothers had an increased incidence of low Apgar score of 4 - 6 at 5 minutes than other mothers who gave birth at Monash Health during 2014. The overall proportion of live born babies in Australia that had a low Apgar score (between 0 and 6) in 2012 was 1.7% (Hilder, Zhichao, et al., 2014).

Apgar scores <7 at 5 minutes is an indicator of newborn asphyxia a condition caused by lack of oxygen to the brain (R. Smith et al., 2013). Immigrant and Indigenous mothers are more likely to have babies with a low Apgar score than other mothers (Cacciani et al., 2011). Older aged mothers and teenage mothers are also at increased risk for having a baby with an Apgar <7 at 5 minutes (Chen et al., 2007; Jahromi & Husseini, 2008).

Indian-born mothers have an increased incidence for having babies with low and very low Apgar scores. This increased risk could be directly related to the higher incidence of very preterm and preterm births. It could also be a complication associated with avoidable maternal medical conditions (gestational diabetes, hypothyroidism, anaemia), for which Indian born mothers are at increased risk. It has been suggested that any one of these medical conditions could affect optimal pregnancy hormone balance and placental function, however these associations are unproven. Indian-born mothers are not at risk for older maternal age or teenage pregnancy.

This study was unable to identify a common risk factor predisposing babies of Indian-born mothers to increased risk for low and very low Apgar score, except in cases of preterm and very preterm birth. Further research is required to test associations for low Apgar score at 5 min among immigrant mothers and Indian-born mothers.

5.3.3 Nurseries Admission

The largest proportion of babies admitted to neonatal intensive care following birth were born to Australian-born mothers compared to other mothers in 2014 who gave birth in Monash Health hospitals. Whereas, babies of Indian-born mothers made up the largest proportion admitted to special care nurseries. Babies with life threatening illness are admitted to neonatal intensive care whilst babies who are stable, but require close monitoring, are admitted to special care nurseries. The increased admission to special care nurseries of babies born to Indian-born mothers is consistent with an increased incidence of low birth weigt babies <2,499 grams. Babies classified as low birth weight are routinely admitted to special care for glucose monitoring and remain until stable and feeding. Babies born 20-27 weeks premature with very low birth weight <2,000 grams would routinely be admitted to neonatal intensive care for respiratory management. Babies with Apgar scores <7 but greater than 4 at 5 minutes who have responded well to resuscitation at birth would be admitted to special care nurseries. Live born babies with an Apgar score of <4 at 5 minutes would be admitted to the neonatal intensive care nursery. These babies are at increased risk for ongoing neurological damage.

It appears that live born babies of Indian-born mothers are at risk for non life threatening adverse perinatal outcomes compared to babies of Australian-born mothers, whose babies are born sicker and require life-saving neonatal intensive care. Babies of mothers with obstetric complications, such as placenta previa, are also more likely to require life saving neonatal intensive care (Norgaard et al., 2012). Pregnancies complicated by placenta previa had an increased risk of neonates being born preterm and being of low birth weight or suffering from birth asphyxia, thus requiring intensive neonatal care (Ananth, Demissie, Smulian, & Vintzileos, 2001; Ananth, Smulian, & Vintzileos, 2003; T. Rosenberg et al., 2011; Salihu, Li, Rouse, & Alexander, 2003). Severe birth asphyxia in response to prolonged lack of oxygen during labour is associated with the most severe adverse perinatal outcomes.

Neonatal Morbidity: Details related to neonatal morbidity were only obtained from Monash Health (BOS) 2014 hospital data. Babies of Indian-born mothers were more likely to require blood glucose monitoring following birth compared to other mothers. Blood glucose monitoring is standard practice for all low birth weight babies <2,499 grams who are routinely admitted to special care nursery. Consequently small healthy babies that fall just inside the weight range are included in this ally.

Blood Glucose Monitoring: Indian-born mothers have an increased risk for gestational diabetes mellitus, a disease that, if not treated effectively, affects fetal serum blood glucose. Babies born to mothers diagnosed with gestational diabetes are routinely admitted to special care nursery for a series of blood glucose monitoring. Management of the baby of a mother with gestation diabetes becomes complicated if the mother

also has a vitamin D deficiency, something more likely to occur in Indian-born women. This combination of maternal medical conditions is associated with neonatal hypoglycaemia (Weinert et al., 2016). Neonatal hypoglycaemia is life threatening condition that requires emergency medical treatment following birth (Group, 2008).

Neonatal Jaundice: Neonatal jaundice was increased among babies born to Indian-born mothers compared to babies of others mothers. Neonatal jaundice (hyperbilirubinemia) is a frequent condition in the newborn (Smitherman, Stark, & Bhutan, 2006), a condition which is exentuated in babies born with Apgar scores <7. An increased production rate of bilirubin and a decreased rate of conjugation are jointly responsible for the occurrence of neonatal hyperbilirubinemia (Guillemette, 2003). Healthy term babies are able cope with neonatal jaundice maintain serum bilirubin levels within a healthy range. Babies who are preterm and low birth weight are at greatly inceased risk for developing hyperbilirubinaemia requiring medical treatment. Babies of Asian mothers in general have increased risk factors for developing neonatal jaundice as a result of birth stress and delayed feeding (Long, Zhang, Fang, Luo, & Liu, 2011; Zuppa et al., 2013).

Following birth, babies of Indian-born mothers are more likely to be admitted to special care nursery for serum blood glucose monitoring and routine observation. This current study was unable to identify the incidence of small healthy babies of Indian-born mothers that were routinely admitted to special care nursery for serum blood glucose monitoring, based on birth weight classification, and who required no further intervention.

5.4 Study Limitations

This study findings report that low risk Indian-born mothers were found to have increased rates of adverse perinatal outcomes in Australia compared to other mothers gaving birth in Australia during the study period. However, the limitations of the study are:

- Findings from this study are restricted to Indian-born mothers who gave birth in Australia in 2012 and at Monash Health hospitals during 2014.
- The data sets do not report some pre-existing maternal medical, obstetric, and gynaecologic factors necessary to address the research questions.
- The 2012 National Perinatal Data and 2014 Monash Health (BOS) hospital Data sets were collected for another purpose, unrelated to this study, and were collected in different years.
- Only first generation Indian-born mothers could be identified in both data sets.
- The majority of data was provided in aggregated form, which limits the range and number of possible statistical analyses, and, thus, limits the study's findings.
- The study was unable to identify a common risk for adverse perinatal outcomes due to the limitation of the data sets.

5.5 Conclusions

The current study makes some unique contributions. The findings reveal that Indian-born mothers possess many protective factors that are expected to minimise adverse perinatal outcomes, such as being married, singleton plurality, access to antenatal

care involving qualified maternity care professionals, normal BMI, non-smoking and lack of substance abuse during pregnancy, and giving birth in a public hospital fully equipped to manage complications. Despite all these protective factors, Indian-born mothers giving birth in Australia still face an increased risk for adverse perinatal outcomes. Indian-born mothers are at greatest risk for preterm birth, low birth weight and very low Apgar @ 5 minutes.

Indian-borns mothers are at increased risk for avoidable dietary defieciencies resulting in iron deficiency anaemia, vitamin D and vitamin B & B12 deficiency and hypothyroidism due to low iodine intake. They are also at increased risk for gestational diabetes, polycystic ovary disease, and pregnancy complications (such as oligohydramnios, placenta accrete, placenta previa, and prolonged pre-rupture of membranes) when compared to Australian-born and other overseas-born mothers. Indian-born mothers have the largest rates for birth complication including, increased rates of induced labour; increased rates of instrumental delivery (including forceps or vacuum extraction), and the highest rates for caesarean section delivery.

Premature placental ageing and placental dysfunction has been proposed as a risk factor in unexplained late term stillbirth, small for gestational age babies, and babies of low birth weight. It is suggested that Asian ethnicity plays a role in which placenta's will age prematurely. Due to increased risk in late pregnancy, it is suggested that the optimal time for Indian-born mothers for delivery is 38-39 weeks. In the absence of more conclusive information, an association between maternal medical conditions more prevalent in Indian-born mothers and very preterm birth 20-27 weeks is

suggested. The increased incidence of low Apgar score is a complication of increased rates of very preterm and preterm birth, very low birth weight and obstetric emergencies.

Babies of Indian-born mothers have been admitted to special care nurseries in much greater numbers than other babies. Adherence to hospital policies requiring all babies with birthweight < 2,500 grams is the likely to explanation for this difference. Indian-born mothers are known for having small healthy babies, the birth weight of which may fall just under the 2,500 gram cut off. This current study was unable to differentiate between the number of sick babies compared to small healthy babies that were admitted to special care nurseries.

Findings from the current study confirm that Indian-born mothers living and giving birth in Australia are at increased risk of adverse perinatal birth outcomes. Risk factors associated with Indian-born mothers differ from those routinely considered for pregnant women in general populations. It is recommended that dietary deficiency diseases be eradicated in young women of childbearing age. A further recommendation related to the need for antenatal care provided to Indian-born mothers be tailored, to manage specific risks (maternal medical conditions) contributing to increased risk for adverse perinatal outcomes.

Chapter Six discusses the recommendations for maternal and perinatal practice, researchers, education and policy makers.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Chapter six presents the conclusions, recommendations, and implications of the study. This study is the first to examine the incidence of adverse perinatal outcomes among Indian-born mothers compared to other mothers giving birth in Australia. The research questions are:

1. What identifiable socio-demographic risk factors, as they relate to obstetrics, are present prior to or during labour/delivery that can predict adverse perinatal outcomes among Indian-born mothers in Australia?
2. How do these outcomes compare to other overseas-born mothers in Australia?

This current study has confirmed that Indian-born mothers are at an increased risk for some adverse perinatal outcomes compared with other mothers giving birth in Australia in the study period. The specific adverse perinatal outcomes for babies of Indian-born mothers giving birth in Australia were found to be low to very low birth weight, very pre-term birth, small for gestational age, stillbirth, and Apgar score less than 2 @ 5 minutes. These adverse perinatal outcomes do not occur independently of each other. For example, very preterm birth exposes the baby to very low birth weight, low Apgar score @ 5 minutes and admission to neonatal care. Likewise, obstetric complications such as induction of labor, instrumental birth, and placenta previa may predispose the baby to suboptimal Apgar and nursery admission.

Additionally, this study also found that Indian-born mothers experienced higher rates of several medical conditions, some of which are avoidable. Dietary related disease including insufficient iron deficiency anaemia, vitamin D deficiency, vitamin B and B12 deficiencies and hypothyroidism, are all avoidable. Community awareness campaigns informing Indian communities regarding healthy diets for young women, have been in existence for some years in India (Griffiths & Bentley, 2001). However, cultural practices including high rates of vegetarianism and the high cost of protein may be factors that influence the diets of Indian migrants living in Australia. To achieve cultural change regarding adequate diets for young women planning for a baby in the future, requires community awareness campaigns targeted at migrant communities in Australia.

Maternal country of birth is an independent risk factor for adverse perinatal outcomes (H. G. Dahlen et al., 2013; Drysdale et al., 2012). Asian maternal ethnicity may be associated with early placental ageing and dysfunction, placing the fetus at risk in late pregnancy (M. Davies-Tuck et al., 2017). Placental monitoring from mid to late pregnancy is suggested (M. L. Davies-Tuck et al., 2017). The presence of dietary deficiency diseases in young Indian–born mothers living in Australia is highly unexpected and requires urgent community attention. Eradicating these avoidable conditions must be a priority in reducing risk for adverse perinatal outcomes.

Antenatal care for Indian-born mothers needs to be tailored to take into consideration the common maternal medical conditions and dietary deficiencies faced by these mothers. Close antenatal monitoring of indicators for fetal wellbeing and normal fetal

growth are also required. Maternal health should be closely measured for risks which may predispose the mother to very preterm birth. Advances in technology that accurately measure placental health at various stages throughout pregnancy are required.

6.2 Implications of the Study Findings

Indian-born mothers who gave birth in 2012 had an increased risk for adverse perinatal outcomes. This finding was confirmed for mothers who gave birth in 2014 at a large metropolitan maternity hospital in Victoria. This increased risk is unexpected, as these mothers have received quality maternity care in a well resourced Western country. Australia is recognised as one of the safest countries to have a baby (Health & Ageing, 2009). Indian-born mothers give birth in maternity hospitals surrounded by expert maternity care professionals and state-of-the-art medical technology.

In this current study, Indian-born mothers attend optimal antenatal appointments. However, healthy young Indian-born mothers experience greater rate of obstetric and medical interventions. There is an association between placental abnormalities, fetal growth, and stillbirth (Bukowski et al., 2017).

Indian-born mothers were not impacted by the widely recognised risk factors for adverse perinatal outcomes including: being a single mother, older maternal age, smoking, BMI >30, giving birth without medical care, and poor antenatal attendance. However, they continue to be at increased risk for induction of labour, emergency caesarean section birth, Apgar scores @ 5 minutes (0-2), prematurity (gestational age

20–27 weeks), birth weight <1,000 grams & 2000 – 2,499 grams, and also have a risk of a stillbirth. It is important to note that Indian-born mothers do have increased risk for avoidable diseases related to dietary deficiency, gestational diabetes and hypothyroidism. These findings have implications in three major areas including: maternal and perinatal practice; maternal and perinatal policy; and maternal and perinatal research.

6.3 Recommendation for Maternal and Perinatal Practice

Further research is required

- Develop an effective model of antenatal and birth care that includes more frequent monitoring of maternal and fetal wellbeing than is routinely provided.
- Tailored antenatal care provided by specialist maternity care professionals with expertise in managing maternal medical conditions or dietary deficiency diseases in pregnancy.
- Encourage participation of Indian-born mother in models of continuity of maternity care . Understanding the specific healthcare needs of migrant women in pregnancy and following birth is important to inform health service design and delivery, and ensure the best health outcomes for women and babies.
- Maternity health care providers are encouranged for incorporating routine psychosocial screening during antnenatal care regarding the effectiveness of current Intimate partner violence (IPV; physical, sexual or emotional), and provide appropriate services for women from other countries.
- To evaluate effective support strategies for migrant women in the perinatal

period.

6.4 Recommendation for Maternal and Perinatal Policy

The recommendations include:

- It is a strong recommendation of this study that maternal ethnicity be recognised as a risk for adverse perinatal outcomes, and that Indian-born mothers be recognised as an at-risk group for the purposes of antenatal care delivery.
- In order for future research to identify maternal risk factors for adverse perinatal outcomes, the National Perinatal Data Collection survey needs to include information on maternal medical history uniformly from all Australian States and Territories.
- To reduce the incidence of maternal dietary deficiency diseases, community awareness campaigns are required highlighting the dietary needs of young Indian women who plan to have babies in the future.

6.5 Recommendation for Maternal and Perinatal Research

The recommendations include:

- An intervention study comparing individual perinatal outcomes with the presence of maternal medical conditions.
- An intervention study to identify the role of premature placental aging in preterm birth and still birth in mid to late pregnancy.
- A descriptive study investigating Indian-born mothers' experiences of maternity care in Australia.

- An intervention study that differentiates between healthy small babies and sick low birth weight babies for Indian-born mothers.

6.6 Conclusion

This research is the first of its kind in Australia that investigates Indian-born mothers risk for adverse perinatal outcomes as a discrete group. The study makes a significant and timely contribution to the specific risks faced by Indian-born mothers, risks that are not routinely considered. Indian-born mothers should be monitored more closely antenatally than currently recommended for low risk women. This current research confirms that Indian-born mothers are at an increased risk for adverse perinatal outcomes compared with other mothers having babies in Australia.

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Appendices

Appendix 1 Ethics Approval from Monash University

MONASH University
Monash University Human Research Ethics Committee (MUHREC)
Research Office

29 April 2015

Dear Researchers

Project Number:	**CF15/1241 - 2015000581**
Project Title:	**Perinatal outcomes among Indian mothers in Australia - An Epidemiological study**
Chief Investigator:	**Assoc Prof Meredith McIntyre**

The above application has been reviewed by the Chairs of the Monash University Human Research Ethics Committee (MUHREC) who determined that the proposal satisfies section 5.1.22 of the National Statement on Ethical Conduct in Human Research.

Therefore, the Committee has granted an exemption from ethical review for the research as described in your proposal.

Thank you for your assistance.

[redacted]

Professor Nip Thomson
Chair, MUHREC

cc: Dr Beverley Copnell, Mrs Kanmani Barthasarathy

Monash University, Room 111, Chancellery Building E
[redacted]
ABN 12 377 614 012 CRICOS Provider #00008C

Appendix 2 Ethics Approval from Monash Health

[redacted]

MonashHealth

Research Support Services
Monash Health
[redacted]

[redacted]

03 February 2017

A/prof Meredith McIntyre
Faculty of Medicine, Nursing, Health Sciences
Monash University
Frankston Vic 3199

Dear Researcher,

Study title: Is there a difference in perinatal outcomes for South Asian born Mothers and other Mothers?
NMA HREC Reference Number: HREC/17/MonH/11
Monash Health Ref: RES-17-0000017L

The Monash Health Human Research Ethics Low Risk Review Panel reviewed the above application at their virtual meeting on 19 January 2017 and are also satisfied that the responses to our correspondence of 24 January 2017 have been sufficiently addressed.

The Human Research Ethics Low Risk Review Panel approved the above application on the basis of the information provided in the application form, protocol and supporting documentation.

Monash Health is accredited by the Consultative Council for Human Research Ethics under the single ethical review system.

Approval

The Human Research Ethics Low Risk Review Approval and Site Specific Authorisation is from the date of this letter.

Approval is given in accordance with the research conforming to the *National Health and Medical Research Council Act 1992* and the *National Statement on Ethical Conduct in Human Research (2007)*. The HREC has ethically approved this research according to the Memorandum of Understanding between the Consultative Council and the participating organisations conducting the research.

Approval is given for this research project to be conducted at the following sites and campuses:

- Monash Health
- Monash University

You must comply with the following conditions:

The Principal Investigator is required to notify the Research Support Services, Monash Health of the following:

1. Any change in protocol and the reason for that change together with an indication of ethical implications (if any)
2. Serious or unexpected adverse effects of project on subjects and steps taken to deal with them
3. Any unforeseen events that might affect continued ethical acceptability of the project

4. Any expiry of the insurance coverage provided in respect of sponsored trials
5. Discontinuation of the project before the expected date of completion, giving reasons
6. Any change in personnel involved in the research project including any study member resigning from Monash Health &/or the study team.

At the conclusion of the project or every twelve months if the project continues, the Principal Investigator is required to complete and forward an annual progress report to the Committee.

Annual progress report reminder letters will be forwarded to the researcher.

Approved documents

Documents reviewed and approved by the Low Risk Review Panel were:

Document	*Version*	*Date*
National Ethics Application Form		2/2/2017

If you should have any queries about your project please contact Julie Gephart by email julie.gephart @southernhealth.org.au

Yours sincerely

[redacted]

Professor Andis Graudins
Medical Administrator
Date:

[redacted]
Deputy Chair, HREC

Cc: Prof Christine East, Monash Health

Appendix 3 List of Variables Available in Both Data Sets

Variables	National Perinatal Data 2012	Monash Health (BOS) Data 2014
Country of birth	✓	✓
Maternal age	✓	✓
SEIFA IRSD	✓	×
Maternal parity	✓	✓
Plurality	✓	✓
Maternal marital status	✓	✓
Substance abuse	✓	✓
Maternal BMI (kg/m^2)	✓	×
Maternal medical conditions	×	✓
Past history	×	✓
Duration of pregnancy at first antenatal visit (in weeks)	✓	×
Number of antenatal visits	✓	×
Intended place of birth	✓	×
Actual place of birth	✓	×
Hospital sector	✓	×
Method of birth	✓	✓
Onset of labour	✓	✓
Birth status	✓	✓
Presentation	✓	✓
Gestational age (in weeks)	✓	✓
Birth weight	✓	✓
Past history	×	✓
Birth defect	×	✓
Obstetric complication	×	✓
Neonatal morbidity	×	✓
Admission to special care nurseries(SCN) or neonatal intensive care units(NICU)	×	✓

Appendix 4 Description of the Variables

Variable	Categories in NPD	Categories in MHD
Country of birth	Indian-born Australian-born Overseas-born	Indian-born Australian-born Overseas-born
Maternal age	<20 years 20–24 years 25–29 years 30–34 years 35–39 years >=40 years Not stated	<20 years 20–24 years 25–29 years 30–34 years 35–39 years >=40 years Not stated
SEIFA IRSD	1 – 2 decile 3 – 4 decile 5 – 6 decile 7 - 8 decile 9 – 10 decile Not stated	Not available
Maternal parity	None One Two Three Four or more Not stated	None One Two Three Four or more
Plurality	Singleton Multiple Not stated	Singleton Multiple
Marital status	Married (including de facto) Widowed/divorced/separated Never married or single Not stated	Married (including de facto) divorced/separated single

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Substance abuse	Smoked Did not smoked Not stated	Smoking Nil Alcohol Amphetamines Benzodiazepine Buprenorphine Cannabis others
Maternal BMI (kg/m^2)	Less than 18.5 18.5 - 24.9 25.0 - 29.9 30 and over Not stated	Not available
Duration of pregnancy at first antenatal visit (weeks)	Less than 14 14 – 19 20 – 29 30 - 37 38 and over Not applicable Not stated	Not available
Number of antenatal visits	None or 1 2 – 5 6 – 9 10 - 13 14 – 18 19 or more Not stated	Not available
Intended place of birth	Hospital Birth centre Home Other Not stated	Not available

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Actual place of birth	Hospital Birth centre Home Other Not stated	Not available
Hospital sector	Public Private	Not available
Type of birth	Non-Instrumental vaginal Forceps Vacuum extraction Caesarean section Not stated	Non-Instrumental vaginal Forceps Vacuum extraction Elective Caesarean section Emergency Caesarean section -
Onset of labour	Spontaneous Induced No labour Not stated	Spontaneous Induced No labour -
Presentation	Vertex Breech Face or brow other Not stated	Vertex Breech Face other -
Birth status	Live birth Fetal deaths (stillbirths) Not stated	Live birth Fetal deaths (stillbirths) -
Gestational age (weeks)	20 – 27 28 – 31 32 – 36 37 - 41 42 and over Not stated	- - - 37 – 41 41.1 – 42.2 -

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Birth weight (Grams)	Less than 1000 1000 – 1499 1500 – 1999 2000 – 2499 2500 – 2999 3000 – 3499 3500 – 3999 4000 – 4499 4500 and over Not stated	- - 1730 – 1999 2000 – 2499 2500 – 2999 3000 - 3499 3500 – 3999 4000 – 4499 4500 and over
Apgar score (at 5 minutes)	0 – 2 3 – 5 6 – 8 9 – 10 Not stated	0-3 4-6 7-10 Not stated
Admission to special care nurseries(SCN) or neonatal intensive care units(NICU)	Not available	NICU No SCN Not stated
Birth defect	Not available	Cardiovascular Chromosomal abnormality CNS Gastrointestinal Gene defects Known Syndrome Musculoskeletal Respiratory Skin Urogenital Others Not stated

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Maternal medical condition	Not available	Anaemia Anxiety State Asthma Auto-Immune Disease Bi-cornuted Uterus Cancer of Cervix Cardiac Condition Chronic Bowel Disease Chronic Renal Disease Depression Diabetes Mellitus Endometriosis Epilepsy Fibroids Genital Herpes Thyroidism Increased BMI Others Vitamin D Deficiency Vitamin B12 Deficiency Urinary tract infection=21; Polycystic Ovary Not stated

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Past history	Not available	Antenatal Haemorrhage Cervical Ligation GDM Genetic Abnormality Genital Herpes History of Anorexia History of Anxiety History of Cancer of Cervix History of Cervical Dysplasia History of Depression History of Epilepsy Manual Removal of Placenta Postnatal Depression Postpartum Haemorrhage Pre-eclampsia Previous Caesarean Section Others Not stated

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Neonatal morbidity	Not available	ABO isoimmunisation Anaemia <10grams Apnoeic attacks Birth trauma Blood glucose monitoring Bradycardia Breastfeeding attachment difficulties Cephalhaematoma Cyanotic attacks Group B strep Hypothermia Infant of a diabetic mother Jaundice Macrosomia Management of birth defect Meconium aspiration syndrome Meningitis Metabolic acidosis Neonatal Drug Withdrawal Syndrome Neonatal feeding problems Neonatal hypoglycaemia Nil Observation only Others Not stated

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Description of the Variables

Variable	Categories in NPD	Categories in MHD
Obstetric complications	Not available	Advanced maternal age APH Breech presentation Cervical incompetence Fetal abnormality Fetal death Gestational diabetes Grand multigravida Hyperemesis gravidarum Macrosomia No antenatal attendance Oblique lie Oligohydramnios Pelvic instability Placenta accrete/Previa Polyhydramnios Poor antenatal attendance Poor obstetric history Pre-eclampsia Pregnancy induced hypertension Prelabour rupture of membrane Prolonged pregnancy >41 weeks Prolonged pre-labour rupture of membrane Others Not stated

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Appendix 5 National Perinatal Data 2012 vs Monash Health (BOS) Data

Table 9. ***Maternal Age (in years) and Mothers' Country of Birth (NPD VS MHD)***

Maternal age (in years)	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
<20	12	0	0.12	0.0	9,904	57	4.61	4.7	1,219	20	1.40	1.3
0 - 24	783	33	7.60	8.4	33,059	196	15.38	16.2	8,422	176	9.69	11.2
25 - 29	4,673	149	45.38	37.9	59.394	361	27.62	29.8	22,638	440	26.04	28.1
30 - 34	3,850	174	37.39	44.3	66,448	335	30.90	27.7	31,320	587	36.02	37.4
35 - 39	860	30	8.35	7.6	37,295	204	17.35	16.8	18,652	268	21.45	17.1
>=40	118	7	1.15	1.8	8,856	58	4.12	4.8	4,681	77	5.38	4.9
Not stated	1	-	0.01	-	53	-	0.02	-	13	-	0.01	-
Total	10,297	393	100	100	215,009	1211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 10. ***Maternal Parity and Maternal Country of Birth (NPD VS MHD)***

Maternal parity	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
None	6,184	232	60.06	59.0	8,8019	533	40.94	44.0	38,371	655	44.13	41.8
One	3,355	137	32.58	34.9	71,200	387	33.11	32.0	28,844	510	33.17	32.5
Two	469	19	4.55	4.8	32,529	188	15.13	15.5	11,097	210	12.76	13.4
Three	63	5	0.61	1.3	11,444	65	5.32	5.4	4,096	102	4.71	6.5
Four or More	10	0	0.10	0.0	7,689	38	3.58	3.1	3,217	91	3.70	5.8
Not stated	216	-	2.10	-	4,128	-	1.92	-	1,320	-	1.52	-
Total	10,297	393	100	100	215,009	1211	100	100	86,945	1568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 11. ***Plurality and Maternal Country of Birth (NPD VS MHD)***

Plurality	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Singleton	10,053	385	97.63	98.0	208,262	1175	96.86	97.0	84,640	1526	97.35	97.3
Multiple	244	8	2.37	2.0	6,746	36	3.14	3.0	2,305	42	2.65	2.7
Not stated	-	-	0.00	-	1	-	0.00	-	0	-	0.00	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 12. ***Marital Status and Maternal Country of Birth (NPD VS MHD)***

Marital status	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Married (including de facto)	10,082	386	97.91	98.2	176,118	796	81.91	65.7	78,312	1375	90.07	87.7
Widowed/divorced/ separated	22	0	0.21	0.0	2,449	17	1.14	1.4	1,053	18	1.21	1.1
Never married	95	7	0.92	1.8	33,050	398	15.37	32.9	6,175	175	7.10	11.2
Not stated	98	-	0.95	-	3,392	-	1.58	-	1,405	-	1.62	-
Total	10,297	393	100	100	215,009	1211	100	100	86,945	1568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 13. ***Substance Abuse and Maternal Country of Birth (NPD VS MHD)***

Substance abuse	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Smoking	29	1	0.28	0.3	33,623	235	16	19.4	4,568	87	5.25	5.5
Did not smoked	10,158	-	98.65	-	176,688	-	82	-	81,493	-	93.73	-
Nil	-	389	-	99.0	-	865	-	71.4	-	1447	-	92.3
Alcohol	-	2	-	0.5	-	35	-	2.9	-	23	-	1.5
Amphetamines	-	0	-	0.0	-	19	-	1.6	-	1	-	0.1
Benzodiazepine	-	0	-	0.0	-	6	-	0.5	-	0	-	0.0
Buprenorphine	-	0	-	0.0	--	3	-	0.2	-	1	-	0.1
Cannabis	-	0	-	0.0	-	37	-	3.1	-	7	-	0.4
Others	-	1	-	0.3	-	11	-	0.9	-	2	-	0.1
Not stated	110	-	1.07	-	4,698	-	2	-	884	-	1.02	-
Total	10,297	393	100	100	215,009	1211	100	100	86,945	1568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 14. ***Onset of Labour and Maternal Country of Birth (NPD VS MHD)***

Onset of labor	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Spontaneous	5,393	203	52.37	51.7	112,831	618	52.48	51.0	49,826	950	57.31	60.6
Induced	3,038	132	29.50	33.6	58,379	387	27.15	32.0	20,565	403	23.65	25.7
No labour	1,863	58	18.09	14.8	43,733	206	20.34	17.0	16,535	215	9.02	13.7
Not stated	3	-	0.03	-	66	-	0.03	-	19	-	0.02	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 15. ***Birth Status and Maternal Country of Birth (NPD VS MHD)***

Birth status	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Live birth	10,206	392	99.21	99.7	213,437	1210	99.27	99.9	86,316	1567	99.28	99.9
Fetal deaths (stillbirths)	91	1	0.88	0.3	1,544	1	0.72	0.1	620	1	0.71	0.1
Not stated	-	-	-	-	28	-	0.01	-	9	-	0.01	-
Total	10,297	393	100	100	215,009	1211	100	100	86,945	1568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 16. ***Birth Weight (in grams) and Maternal Country of Birth (NPD VS MHD)***

Birth weight (in grams)	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Less than 1,000	119	-	1.16	-	1,830	-	0.85	-	718	-	0.83	-
1,000-1,499	70	-	0.68	-	1,394	-	0.65	-	453	-	0.52	-
1,500-1,999	153	-	1.49	-	2,850	-	1.33	-	1,008	-	1.16	
1,730- 1,999	-	3	-	0.8	-	3	-	0.2	-	2	-	0.1
2,000-2,499	587	26	5.70	6.6	8,587	31	3.99	2.6	3,265	45	3.76	2.9
2,500-2,999	2,523	93	24.50	23.7	30,082	203	13.99	16.8	14,898	273	17.13	17.9
3,000-3,499	4,246	179	41.24	45.5	74,525	435	34.66	35.9	33,972	645	39.07	41.1
3,500-3,999	2,174	77	21.11	19.6	68,404	381	31.81	31.5	24,467	429	28.14	27.4
4,000-4,499	380	12	3.69	3.1	23,117	135	10.75	11.1	6,965	146	8.01	9.3
4,500 and over	40	3	0.39	0.8	4,076	23	1.90	1.9	1,147	28	1.32	1.8
Not stated	5	-	0.05	-	144	-	0.07	-	52		0.06	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 17. ***Presentation and Maternal Country of Birth (NPD VS MHD)***

Presentation	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Vertex	9,742	378	94.61	96.2	202,623	1151	94.24	95.0	82,240	1503	94.59	95.9
Breech	419	13	4.07	3.3	9,242	53	4.30	4.4	3,621	49	4.16	3.1
Face or brow	21	2	0.20	0.5	625	2	0.29	0.2	194	1	0.22	0.1
Other	107	0	1.04	0.0	1,913	5	0.89	0.4	789	15	0.91	1.0
Not stated	8	-	0.08	-	606	-	0.28	-	101	-	0.21	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 18. ***Method of Birth and Maternal Country of Birth (NPD VS MHD)***

Method of birth	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
Normal vaginal	4,373	156	42.47	39.7	119,554	621	55.60	51.3	47,094	865	54.17	55.2
Forceps	928	78	9.01	19.8	8,489	155	3.95	12.8	4,049	181	4.66	11.5
Vacuum extraction	1,142	26	11.09	6.6	16,392	56	7.62	4.6	7,425	93	8.54	5.9
Caesarean section	3,853	-	37.42	-	70,559	-	32.82	-	28,370	-	32.63	-
Elective caesarean section	-	53	-	13.5	-	199	-	16.4	-	206	-	13.1
Emergency caesarean section	-	80	-	20.4	-	180	-	14.9	-	223	-	14.2
Not stated	1	-	0.01	-	15	-	0.01	-	7	-	0.01	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 19. ***Apgar Score (at 5 minutes) and Maternal Country of Birth (NPD VS MHD)***

Variables	Indian-born				Australian-born				Other overseas-born			
Apgar score (at 5 minutes)	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
0 - 2	117	1	1.14	0.3	1,954	4	0.91	0.3	801	8	0.92	0.3
3 - 6	152	5	1.48	1.3	3,320	15	1.54	1.2	1,200	18	1.38	1.1
7 - 10	10,017	386	97.28	98.2	209,332	1185	97.36	97.9	84,818	1539	97.55	98.2
Not stated	11	1	0.11	0.3	403	7	0.19	0.6	126	8	0.14	0.5
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Table 20. ***Gestational Age (in weeks) and Maternal Country of Birth (NPD VS MHD)***

Gestational age (in weeks)	Indian-born				Australian-born				Other overseas-born			
	n		%		n		%		n		%	
	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD	NPD	MHD
20 - 27	119	-	1.16	-	1,819	-	0.88	-	677	-	0.78	-
28 - 31	58	-	0.56	-	1,779	-	0.83	-	599	-	0.69	-
32 - 36	667	-	6.48	-	15,602	-	7.26	-	5,210	-	5.99	-
37 - 41	9,394	341	91.23	86.8	194,433	1,039	90.43	85.8	79,920	1,381	91.92	88.1
42 and over	57	52	0.55	13.2	1,310	172	0.61	14.2	525	187	0.60	11.9
Not stated	2	-	0.02	-	66	-	0.03	-	14	-	0.02	-
Total	10,297	393	100	100	215,009	1,211	100	100	86,945	1,568	100	100

Note. NPD = National Perinatal Data; MHD = Monash Health (BOS) Data

Appendix 6 National Perinatal Data 2012 only

Table 21. ***Maternal Age (in years) and Country of Birth (NPD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Maternal age (in years)						
< 20	12	0.12	9,904	4.61	1,219	1.40
20 – 24	783	7.60	33,059	15.38	8,422	9.69
25 – 29	4,673	45.38	59,394	27.62	22,638	26.04
30 – 34	3,850	37.39	66,448	30.90	31,320	36.02
35 - 39	860	8.35	37,295	17.35	18,652	21.45
≥40	118	1.15	8,856	4.12	4,681	5.38
Not stated	1	0.01	53	0.02	13	0.01
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 22. ***SEIFA IRSD (in decile) and Country of Birth (NPD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
SEIFA IRSD (in decile)						
1 - 2	1,910	18.55	45,275	21.06	18,799	21.62
3 - 4	2,521	24.48	43,847	20.39	14,738	16.95
5 – 6	1,960	19.03	42,917	19.96	15,274	17.57
7 – 8	2,060	20.01	40,386	18.78	17,358	19.96
9 - 10	1,586	15.40	36,630	17.04	18,016	20.72
Not stated	260	2.53	5,954	2.77	2,760	3.17
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 23. ***Maternal Parity and Country of Birth (NPD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Maternal parity						
None	6,184	60.06	8,8019	40.94	38,371	44.13
One	3,355	32.58	71,200	33.11	28,844	33.17
Two	469	4.55	32,529	15.13	11,097	12.76
Three	63	0.61	11,444	5.32	4,096	4.71
Four or more	10	0.10	7,689	3.58	3,217	3.70
Not stated	216	2.10	4,128	1.92	1,320	1.52
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 24. ***Marital Status and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Marital status						
Married (including de facto)	10,082	97.91	176,118	81.91	78,312	90.07
Widowed/divorced/separated	22	0.21	2,449	1.14	1,053	1.21
Never married	95	0.92	33,050	15.37	6,175	7.10
Not stated	98	0.95	3,392	1.58	1,405	1.62
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 25. ***Plurality and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Plurality						
Singleton	10,053	97.63	208,262	96.86	84,640	97.35
Multiple	244	2.37	6,746	3.14	2,305	2.65
Not stated	-	0.00	1	0.00	0	0.00
Total	10,297	100	215,009	100	86,945	100

Note. NPD= National Perinatal Data

Table 26. ***Maternal Smoking Status and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Maternal smoking status						
Smoked	29	0.28	33,623	16	4,568	5.25
Did not smoked	10,158	98.65	176,688	82	81,493	93.73
Not stated	110	1.07	4,698	2	884	1.02
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 27. ***Maternal BMI (kg/m^2) and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Maternal BMI (kg/m^2)						
Less than 18.5	254	3.62	4,594	3.12	2,325	4.25
18.5–24.9	3,366	47.91	62,345	42.40	27,228	49.82
25.0–29.9	1,925	27.40	35,981	24.47	12,226	22.37
30 and over	736	10.48	31,289	21.28	7,276	13.31
Not stated	745	10.60	12,821	8.72	5,603	10.25
Total	7,026	100	147,030	100	54,658	100

Note. NPD = National Perinatal Data

Table 28. ***Duration of Pregnancy at First Antenatal Visit (in weeks) and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Duration of pregnancy at first antenatal visit (in weeks)						
Less than 14	6,031	58.57	134,968	62.77	49,131	56.51
14-19	2,416	23.46	43,661	20.31	20,688	23.79
20-29	1,423	13.82	22,770	10.59	11,822	13.60
30-37	258	2.51	4,817	2.24	2,916	3.35
38 and over	17	0.17	653	0.30	270	0.31
Not applicable	17	0.17	486	0.23	186	0.21
Not stated	135	1.31	7,654	3.56	1,932	2.22
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 29. ***Number of Antenatal Visits and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Number of antenatal visits						
None or 1	27	0.43	1,353	0.83	379	0.59
2-5	334	5.34	9,024	5.53	4,094	6.35
6-9	1,872	29.90	38,693	23.72	17,971	27.87
10-13	2,601	41.55	61,547	37.73	23,861	37.01
14-18	344	5.50	9,902	6.07	3,532	5.48
19 or more	50	0.80	1,193	0.73	444	0.69
Not stated	1,032	16.49	41,408	25.38	14,197	22.02
Total	6,260	100	163,120	100	64,478	100

Note. NPD = National Perinatal Data

Table 30. ***Intended Place of Birth and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Intended place of birth						
Hospital	9,997	97.09	205,893	95.76	83,518	96.06
Birth centre	271	2.63	7,395	3.44	2,679	3.08
Home	8	0.08	746	0.35	450	0.52
Other	20	0.19	888	0.41	286	0.33
Not stated	1	0.01	87	0.04	12	0.01
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 31. ***Actual Place of Birth and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Actual place of birth						
Hospital	10,166	98.73	208,238	96.85	84,347	97.01
Birth centre	113	1.10	4,991	2.32	1,841	2.12
Home	5	0.05	553	0.26	368	0.42
Other	13	0.13	1,201	0.56	380	0.44
Not stated	0	0.00	26	0.01	9	0.01
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 32. ***Hospital Sector and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Hospital sector						
Public	8,517	83.78	142,991	68.67	63,353	75.11
Private	1,649	16.22	65,247	31.33	20,994	24.89
Total	10,166	100	208,258	100	84,347	100

Note. NPD = National Perinatal Data

Table 33. ***Method of Birth and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Method of birth						
Normal Vaginal	4,373	42.47	119,554	55.60	47,094	54.17
Forceps	928	9.01	8,489	3.95	4,049	4.66
Vacuum extraction	1,142	11.09	16,392	7.62	7,425	8.54
Caesarean section	3,853	37.42	70,559	32.82	28,370	32.63
Not stated	1	0.01	15	0.01	7	0.01
Total	10,297	100	215,009	100	86,945	100

Note NPD = National Perinatal Data

Table 34. ***Onset of Labour and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Onset of labour						
Spontaneous	5,393	52.37	112,831	52.48	49,826	57.31
Induced	3,038	29.50	58,379	27.15	20,565	23.65
No labour	1,863	18.09	43,733	20.34	16,535	9.02
Not stated	3	0.03	66	0.03	19	0.02
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 35. ***Presentation and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Presentation						
Vertex	9,742	94.61	202,623	94.24	82,240	94.59
Breech	419	4.07	9,242	4.30	3,621	4.16
Face or brow	21	0.20	625	0.29	194	0.22
Other	107	1.04	1,913	0.89	789	0.91
Not stated	8	0.08	606	0.28	101	0.21
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 36. ***Birth Status and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Birth status						
Live birth	10,206	99.21	213,437	99.27	86,316	99.28
Fetal deaths (stillbirths)	91	0.88	1,544	0.72	620	0.71
Not stated	-	-	28	0.01	9	0.01
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 37. ***Gestational Age and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Gestational age (in weeks)						
20 - 27	119	1.16	1,819	0.88	677	0.78
28 - 31	58	0.56	1,779	0.83	599	0.69
32 - 36	667	6.48	15,602	7.26	5,210	5.99
37 - 41	9,394	91.23	194,433	90.43	79,920	91.92
42 and over	57	0.55	1,310	0.61	525	0.60
Not stated	2	0.02	66	0.03	14	0.02
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 38. ***Birth Weight (in grams) and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Birth weight (in grams)						
Less than 1,000	119	1.16	1,830	0.85	718	0.83
1,000-1,499	70	0.68	1,394	0.65	453	0.52
1,500-1,999	153	1.49	2,850	1.33	1,008	1.16
2,000-2,499	587	5.70	8,587	3.99	3,265	3.76
2,500-2,999	2,523	24.50	30,082	13.99	14,898	17.13
3,000-3,499	4,246	41.24	74,525	34.66	33,972	39.07
3,500-3,999	2,174	21.11	68,404	31.81	24,467	28.14
4,000-4,499	380	3.69	23,117	10.75	6,965	8.01
4,500 and over	40	0.39	4,076	1.90	1,147	1.32
Not stated	5	0.05	144	0.07	52	0.06
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Table 39. ***Apgar Score (at 5 minutes) and Country of Birth (NPD)***

Variables	Indian-born		Australian-born		Other overseas-born	
	n	%	n	%	n	%
Apgar score (at 5 minutes)						
0 - 2	117	1.14	1,954	0.91	801	0.92
3 - 6	152	1.48	3,320	1.54	1,200	1.38
7 - 10	10,017	97.28	209,332	97.36	84,818	97.55
Not stated	11	0.11	403	0.19	126	0.14
Total	10,297	100	215,009	100	86,945	100

Note. NPD = National Perinatal Data

Appendix 7 Monash Health (BOS) Data 2014 only

Table 40. ***Maternal Age (in years) and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	N	%
Maternal age (in years)						
<20	0	0.0	57	4.7	20	1.3
20 - 24	33	8.4	196	16.2	176	11.2
25 - 29	149	37.9	361	29.8	440	28.1
30 - 34	174	44.3	335	27.7	587	37.4
35 - 39	30	7.6	204	16.8	268	17.1
>=40	7	1.8	58	4.8	77	4.9
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 41. ***Maternal Parity and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	N	%
Maternal parity						
None	232	59.0	533	44.0	655	41.8
One	137	34.9	387	32.0	510	32.5
Two	19	4.8	188	15.5	210	13.4
Three	5	1.3	65	5.4	102	6.5
Four or more	0	0.0	38	3.1	91	5.8
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 42. ***Plurality and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Plurality						
Singleton	385	98.0	1,175	97.0	1,526	97.3
Multiple	8	2.0	36	3.0	42	2.7
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 43. ***Marital Status and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Marital status						
Married (including de facto)	386	98.2	796	65.7	1,375	87.7
Widowed/divorced/separated	0	0.0	17	1.4	18	1.1
Never married	7	1.8	398	32.9	175	11.2
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 44. *Substance Abuse and Country of Birth (MHD)*

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Substance abuse						
Smoking	1	0.3	235	19.4	87	5.5
Nil	389	99.0	865	71.4	1447	92.3
Alcohol	2	0.5	35	2.9	23	1.5
Amphetamines	0	0.0	19	1.6	1	0.1
Benzodiazepine	0	0.0	6	0.5	0	0.0
Buprenorphine	0	0.0	3	0.2	1	0.1
Cannabis	0	0.0	37	3.1	7	0.4
Others	1	0.3	11	0.9	2	0.1
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 45. ***Onset of Labour and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Onset of labour						
Spontaneous	203	51.7	618	51.0	950	60.6
Induced	132	33.6	387	32.0	403	25.7
No labour	58	14.8	206	17.0	215	13.7
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 46. ***Method of Birth and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Method of birth						
Normal vaginal	156	39.7	621	51.3	865	55.2
Forceps	78	19.8	155	12.8	181	11.5
Vacuum extraction	26	6.6	56	4.6	93	5.9
Elective caesarean section	53	13.5	199	16.4	206	13.1
Emergency caesarean section	80	20.4	180	14.9	223	14.2
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 47. ***Maternal Medical Conditions and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Maternal medical conditions						
Anaemia	31	7.9	49	4.0	74	4.7
Anxiety	2	0.5	68	5.6	16	1.0
Asthma	4	1.0	119	9.8	46	2.9
Auto-Immune Disease	0	0.0	9	0.7	4	0.3
Bi–cornuted Uterus	2	0.5	4	0.3	4	0.3
Cancer of Cervix	0	0.0	2	0.2	0	0.0
Cardiac Condition	2	0.5	26	2.1	16	1.0
Chronic Bowel Disease	1	0.3	11	0.9	1	0.1
Chronic Renal Disease	0	0.0	3	0.2	4	0.3
Depression	3	0.8	45	3.7	24	1.5
Diabetes Mellitus	13	3.3	36	3.0	26	1.7
Endometriosis	1	0.3	8	0.7	4	0.3
Epilepsy	3	0.8	9	0.7	5	0.3
Fibroids	2	0.5	10	0.8	17	1.1
Genital herpes	0	0.0	7	0.6	4	0.3
Thyroidism	36	9.2	29	2.4	57	3.6

Continued…

Note. MHD = Monash Health (BOS) Data

Table 47 *Continues*

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Increased BMI	27	6.9	204	16.8	162	10.3
Others	19	4.8	89	7.3	95	6.1
Vitamin D deficiency	98	24.9	119	9.8	355	22.6
Vitamin B12 deficiency	7	1.8	2	0.2	1	0.1
Urinary tract infection	1	0.3	2	0.2	2	0.1
Polycystic ovary	6	1.5	9	0.7	11	0.7
Not stated	135	34.4	351	29.0	640	40.8
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 48. ***Past History and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Past history						
Antenatal haemorrhage	0	0.0	11	0.9	8	0.5
Cervical ligation	0	0.0	3	0.2	3	0.2
GDM	14	3.6	41	3.4	61	3.9
Genetic abnormality	0	0.0	5	0.4	4	0.3
Genital herpes	0	0.0	26	2.1	10	0.6
History of anxiety	9	2.3	80	6.6	24	1.5
History of anorexia	0	0.0	8	0.7	1	0.1
History of cancer of cervix	1	0.3	1	0.1	2	0.1
History of cervical dysplasia	1	0.3	29	2.4	10	0.6
History of depression	2	0.5	135	11.1	52	3.3
History of epilepsy	2	0.5	5	0.4	3	0.2
Manual removal of placenta	1	0.3	9	0.7	5	0.3
Postnatal depression	4	1.0	21	1.7	25	1.6

Continued…

Note. MHD = Monash Health (BOS) Data

Table 48 *Continues*

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Previous caesarean section	44	11.2	75	6.2	174	11.1
Others	13	3.3	86	7.1	89	5.7
Not stated	293	74.6	606	50.0	1014	64.7
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 49. ***Birth Status and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Birth status						
Live born	392	99.7	1,210	99.9	1,567	99.9
Stillborn	1	0.3	1	0.1	1	0.1
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 50. ***Gestational Age and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Gestational age						
37–41	341	86.8	1,039	85.8	1,381	88.1
41.1–42.2	52	13.2	172	14.2	187	11.9
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 51. ***Presentation and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Presentation						
Vertex	378	96.2	1,151	95.0	1,503	95.9
Breech	13	3.3	53	4.4	49	3.1
Face	2	0.5	2	0.2	1	0.1
Other	0	0.0	5	0.4	15	1.0
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 52. ***Birth Weight and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Birth weight (in grams)						
1,730 – 1,999	3	0.8	3	0.2	2	0.1
2,000 – 2,499	26	6.6	31	2.6	45	2.9
2,500 – 2,999	93	23.7	203	16.8	273	17.9
3,000 – 3,499	179	45.5	435	35.9	645	41.1
3,500 – 3,999	77	19.6	381	31.5	429	27.4
4,000 – 4,499	12	3.1	135	11.1	146	9.3
4,500 and over	3	0.8	23	1.9	28	1.8
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 53. ***Apgar Score (at 5 minutes) and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Apgar score (at 5 minutes)						
0 - 3	1	0.3	4	0.3	8	0.3
4 - 6	5	1.3	15	1.2	18	1.1
7 - 10	386	98.2	1185	97.9	1539	98.2
Not Stated	1	0.3	7	0.6	8	0.5
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 54. ***Admission to Special Care Nurseries or Neonatal Intensive Care Units and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Admission to special care nurseries or neonatal intensive care units						
NICU	10	2.5	33	2.7	22	1.4
No	291	74.0	928	76.6	1,272	81.1
SCN	91	23.2	249	20.6	273	17.4
Not Stated	1	0.3	1	0.1	1	0.1
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 55. ***Neonatal Morbidity and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Neonatal morbidity						
ABO isoimmunisation	2	0.5	0	0.0	4	0.3
Anaemia <10grams	0	0.0	0	0.0	2	0.1
Apnoeic attacks	3	0.8	7	0.6	3	0.2
Birth trauma	1	0.3	5	0.4	3	0.2
Blood glucose monitoring	59	15.0	113	9.3	159	10.1
Bradycardia	1	0.3	9	0.7	8	0.5
Breastfeeding attachment difficulties	12	3.1	34	2.8	51	3.3
Cephalhaematoma	4	1.0	6	0.5	11	0.7
Cyanotic attacks	0	0.0	6	0.5	1	0.1
Group B strep	1	0.3	1	0.1	3	0.2
Hypothermia	14	3.6	31	2.6	47	3.0
Infant of a diabetic mother	8	2.0	27	2.2	46	2.9
Jaundice	42	10.7	101	8.3	149	9.5
Macrosomia	0	0.0	10	0.8	7	0.4
Management of birth defect	2	0.5	16	1.3	2	0.1
Meconium aspiration syndrome	2	0.5	4	0.3	2	0.1

Continued…

Note. MHD = Monash Health (BOS) Data

Table 55 *Continues*

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Meningitis	1	0.3	6	0.5	6	0.4
Metabolic acidosis	0	0.0	7	0.6	12	0.8
Neonatal Drug Withdrawal Syndrome	0	0.0	8	0.7	0	0.0
Neonatal feeding problems	4	1.0	3	0.2	2	0.1
Neonatal hypoglycaemia	4	1.0	9	0.7	16	1.0
Nil	0	0.0	1	0.1	1	0.1
Observation only	46	11.7	127	10.5	141	9.0
Others	37	9.4	89	7.3	107	6.8
Not stated	150	38.2	591	48.8	785	50.1
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 56. ***Birth Defect and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Birth defect						
Cardiovascular	0	0.0	8	0.7	25	1.6
Chromosomal abnormality	0	0.0	1	0.1	4	0.3
CNS	0	0.0	2	0.2	4	0.3
Gastrointestinal	0	0.0	1	0.1	7	0.4
Gene defects	0	0.0	1	0.1	1	0.1
Known syndrome	0	0.0	0	0.0	1	0.1
Musculoskeletal	5	1.3	7	0.6	12	0.8
Respiratory	0	0.0	1	0.1	6	0.4
Skin	0	0.0	3	0.2	0	0.0
Urogenital	0	0.0	3	0.2	6	0.4
Others	1	0.3	2	0.2	6	0.4
Not stated	387	98.5	1182	97.6	1496	95.4
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Table 57. ***Obstetric Complications and Country of Birth (MHD)***

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Obstetric complications						
Advanced maternal age	11	2.8	91	7.5	142	9.1
APH	7	1.8	15	1.2	21	1.3
Breech presentation	12	3.1	26	2.1	27	1.7
Cervical incompetence	0	0.0	3	0.2	7	0.4
Fetal abnormality	3	0.8	45	3.7	17	1.1
Fetal death	1	0.3	0	0.0	1	0.1
Gestational diabetes	49	12.5	61	5.0	154	9.8
Grand multigravida	0	0.0	21	1.7	19	1.2
Hyperemesis gravidarum	1	0.0	2	0.2	3	0.2
Macrosomia	6	1.5	22	1.8	10	0.6
No antenatal attendance	0	0.0	1	0.1	4	0.3
Oblique lie	0	0.0	1	0.1	3	0.2
Oligohydramnios	8	2.0	10	0.8	19	1.2
Pelvic instability	3	0.8	14	1.2	7	0.4
Placenta accrete/Previa	4	1.0	8	0.7	11	0.7
Polyhydramnios	0	0.0	3	0.2	4	0.3
Poor antenatal attendance	0	0.0	21	1.7	21	1.3
Poor obstetric history	4	1.0	20	1.7	16	1.0
Pre-eclampsia	7	1.8	24	2.0	10	0.6
Pregnancy induced hypertension	3	0.8	17	1.4	2	0.1

Continued…

Note. MHD = Monash Health (BOS) Data

Table 57 *Continues*

Variables	India-born		Australia-born		Other overseas-born	
	n	%	n	%	n	%
Prelabour rupture of membrane	45	11.5	150	12.4	200	12.8
Prolonged pregnancy >41 weeks	37	9.4	113	9.3	104	6.6
Prolonged pre-labour rupture of membrane	21	5.3	37	3.1	53	3.4
Others	45	11.5	108	8.9	151	9.6
Not stated	126	32.1	398	32.9	562	35.8
Total	393	100	1,211	100	1,568	100

Note. MHD = Monash Health (BOS) Data

Appendix 8 Recoded Variables to Assist with Further Analysis (NPD)

Recoded Variables for Database

Variables for Categorising (National Perinatal Data 2012)

1. Overall categories country of birth

   Indian-born=1; Australian-born=2; Other Overseas-born=3

2. Overall categories maternal age

   <20 years=1; 20 – 24 years=2; 25 – 29 years=3; 30 – 34 years=4;

   35 – 39 years=5; >=40 years=6; Not stated=7

3. Overall categories SEIFA IRSD

   1 – 2 decile=1; 3 – 4 decile=2; 5 – 6 decile=3; 7 - 8 decile=4; 9 – 10 decile=5;

   Not stated=6

4. Overall categories maternal parity

   None=1; One=2; Two=3; Three=4; Four or more=5; Not stated=6

5. Overall categories Plurality

   Singleton=1; Multiple=2; Not stated=3

6. Overall categories marital status

   Married (including de facto) =1; Widowed/divorced/separated=2;

   Never married or single=3; Not stated=4

7. Overall categories maternal smoking status

   Smoked=1; Did not smoked=2; Not stated=3

8. Overall categories maternal BMI (kg/m^2)

   Less than 18.5=1; 18.5 - 24.9=2; 25.0 - 29.9=3; 30 and over=4; Not stated=5

9. Overall categories first antenatal visit (weeks)

   Less than 14=1; 14 – 19=2; 20 – 29=3; 30 - 37=4; 38 and over=5;

   Not applicable=6; Not stated=7

10. Overall categories number of antenatal visits

    None or 1=1; 2 – 5=2; 6 – 9=3; 10 - 13=4; 14 – 18=5; 19 or more=6;

    Not stated=7

11. Overall categories intended place of birth

    Hospital=1; Birth centre=2; Home=3; other=4; Not stated=5

12. Overall categories actual place of birth

    Hospital=1; Birth centre=2; Home=3; other=4; Not stated=5

13. Overall categories Hospital sector

    Public=1; Private=2

14. Overall categories type of birth

    Non-Instrumental vaginal=1; Forceps=2; Vacuum extraction=3;

    Caesarean section=4; Not stated=5

15. Overall categories onset of labour

    Spontaneous=1; Induced=2; No labour=3; Not stated=4

16. Overall categories presentation

    Vertex=1; Breech=2; Face or brow=3; other=4; Not stated=5

17. Overall categories birth status

    Live birth=1; Fetal deaths (stillbirths)=2; Not stated=3

18. Overall categories gestational age (weeks)

    20–27=1; 28–31=2; 32–36=3; 37-41=4; 42 and over=5; Not stated=6

19. Overall categories birth weight (Grams)

    Less than 1000=1; 1000–1499=2; 1500-1999=3; 2000-2499=4; 2500–2999=5;

    3000-3499=6; 3500-3999=7; 4000–4499=8; 4500 and over=9; Not stated=10

20. Overall categories Apgar score (at 5 minutes)

    0-2=1; 3–5=2; 6-8=3; 9-10=4; Not stated=5

Appendix 9 Recoded Variables to Assist with Further Analysis (MHD)

Recoded Variables for Database

Variables for Categorising (Monash Health (BOS) Data 2014)

1. Overall categories country of birth

   Indian-born=1; Australian-born=2; Overseas-born=3

2. Overall categories maternal age

   <20 years=1; 20–24 years=2; 25–29 years=3; 30–34 years=4;

   35–39 years=5; >=40 years=6; Not stated=7

3. Overall categories maternal parity

   None=1; One=2; Two=3; Three=4; Four or more=5

4. Overall categories plurality

   Singleton=1; Multiple=2

5. Overall categories marital status

   Married (including de facto) =1; divorced/separated=2; single=3

6. Overall categories substance abuse

   Smoking=1; Nil=2; Alcohol=3; Amphetamines=4; Benzodiazepine=5;

   Buprenorphine=6; Cannabis=7; others=8

7. Overall categories first antenatal visit (weeks)

   Less than 14=1; 14–19=2; 20–29=3; 30-37=4; 38 and over=5;

   Not applicable=6; Not stated=7

8. Overall categories maternal medical condition

   Anaemia=1; Anxiety State=2; Asthma=3; Auto-Immune Disease=4; Bi-cornuted Uterus=5; Cancer of Cervix=6;Cardiac Condition=7; Chronic Bowel Disease=8; Chronic Renal Disease=9; Depression=10; Diabetes Mellitus=11; Endometriosis=12; Epilepsy=13; Fibroids=14; Genital Herpes=15; Thyroidism=16; Increased BMI=17; Others=18; Vitamin D Deficiency=19; Vitamin B12 Deficiency=20; Urinary tract infection=21; Polycystic Ovary=22; Not stated=23

9. Overall categories past history

   Antenatal Haemorrhage=1; Cervical Ligation=2; GDM=3; Genetic Abnormality=4; Genital Herpes=5; History of Anorexia=6; History of Anxiety=7; History of Cancer of CervixHistory of Cervical=8; Dysplasia=9; History of Depression=10; History of Epilepsy=11; Manual Removal of Placenta=12; Postnatal Depression=13; Postpartum Haemorrhage=14; Pre-eclampsia=15; Previous Caesarean Section=16; others=17; Not stated=18

10. Overall categories type of birth

    Non-Instrumental vaginal=1; Forceps=2; Vacuum extraction=3; Elective Caesarean section=4; Emergency Caesarean section =5

11. Overall categories Onset of labour

    Spontaneous=1; Induced=2; No labour=3

12. Overall categories presentation

    Vertex=1; Breech=2; Face=3; other=4

13. Overall categories birth status

    Live birth=1; Fetal deaths (stillbirths)=2

14. Overall categories Gestational age (weeks)

    37-41=1; 41.1–42.2=2

15. Overall categories birth weight (Grams)

    1730–1999=1; 2000-2499=2; 2500–2999=3; 3000-3499=4;

    3500-3999=5; 4000–4499=6; 4500 and over=7

16. Overall categories Apgar score (at 5 minutes)

    0-3=1; 4–6=2; 7-0=3; Not stated=4

17. Overall categories admission to special care nurseries(SCN) or neonatal intensive care units(NICU)

    NICU=1; No=2; SCN=3; Not stated=4

18. Overall categories neonatal morbidity

    ABO isoimmunisation=1; Anaemia <10 grams=2; Apnoeic Attacks=3;

    Birth Trauma=4; Blood glucose Monitoring=5; Bradycardia=6;

    Breast feeding attachment difficulties=7; Cephalhaematoma=8;

    Cyanotic Attacks=9; Group B Strep=10; Hypothermia=11;

    Infant of a diabetic mother=12; Jaundice=13; Macrosomia=14;

    Management of Birth Defect=15; Meconium Aspiration Syndrome=16;

    Meningitis=17; Metabolic Acidosis=18;

Neonatal Drug Withdrawal Syndrome=19; Neonatal Feeding Problems=20;

Neonatal Hypoglycaemia=21; Nil=22; Observation only=23; Others=24;

Not stated=25

19. Overall categories birth defect

Cardiovascular=1; Chromosomal abnormality=2; CNS=3; Gastrointestinal=4;

Gene defects=5; Known Syndrome=6; Musculoskeletal=7; Respiratory=8;

Skin=9; Urogenital=10; others=11; Not stated=12

20. Overall categories obstetric complications

Advanced Maternal Age=1; APH=2; Breech Presentation=3;

Cervical Incompetence=4; Fetal Abnormality=5; Fetal death=6;

Gestational Diabetes=7; Grand Multigravida=8; Hyperemesis Gravidarum=9;

Macrosomia=10; No Antenatal Attendance=11; Oblique lie=12;

Oligohydramnios=13; Pelvic Instability=14; Placenta Acreta/Praevia=15;

Poly Hydramnios=16; Poor Antenatal Attendance=17;

Poor Obstetric History=18; Pre-eclampsia=19;

Pregnancy Induced Hypertension=20; Pre-labour Rupture of membrane=21;

Prolonged Pregnancy >41 Weeks=22;

Prolonged pre-labour rupture of membranes=23; others=24