UTS UNIVERSITY OF TECHNOLOGY SYDNEY

An examination of low social support during pregnancy and its association with mental health and quality of life of pregnant women in Australia

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Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Under the supervision of Professor David Sibbritt (principal supervisor), Distinguished Professor Jon Adams (co-supervisor) and Dr Wenbo Peng (co-supervisor)

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Certificate of original authorship

I, Asres Bedaso Tilahune, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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Abbreviations

ALSWH: Australian Longitudinal Study of Women's Health

ANOVA: Analysis Of Variance

AOR: Adjusted Odds Ratio

APDC: Admitted Patient's Data Collection

CALD: Culturally and linguistically diverse

CES-D: Centre for Epidemiologic Studies Depression scale

CHeReL: Centre for Health Record Linkage

CI: Confidence Interval

CPQ: Close Person Questionnaire

DSM–V: Diagnostic and Statistical Manual of Mental Disorders 5th Version

DUSOCS: Duke Social Support and Stress Scale

EDDC: Emergency Department Data Collection

EPDS: Edinburgh Postnatal Depression Scale

GADS: Goldberg Anxiety and Depression Scale

HRQoL: Health-Related Quality of Life

ICD-11: International Statistical Clarification of Disease 11th Version

ISEL: Interpersonal Support Evaluation List

MCS: Mental Component Score

MHRQoL: Mental Health Related Quality of Life

MKSSI: Modified Kendler Social Support Interview

MOS-SSS: Medical Outcomes Study Social Support Scale

MSPSS: Multidimensional Scale of Perceived Social Support

MSSI: Maternal Social Support Index

MSSS: Maternal Social Support Scale

NSW: New South Wales

OR: Odds Ratio

OSS-3: 3-item Oslo social support scale

PANDA: Perinatal Anxiety and Depression Australia

PCS: Physical Component Score

PDC: Perinatal Data Collection

PHRQOL: Physical Health-Related Quality of Life

PNI: Psycho-neuroimmunology

POR: Pooled Odds Ratio

PPP: Antenatal Psychosocial Profile

PRQ: Personal Resource Questionnaire

PSS: Perceived Social Support

PSSS: Partner Social Support Scale

QoL: Quality of Life

QR: Quantile Regression

RCT: Randomised Controlled Trial

SD: Standard Deviation

SPS: Social Provision Scale

SPSS: Statistical Package for Social

SRS: Social relationship Scale

SSQ: Social Support Questionnaire

SSRS: Social Support rating scale

UK: United Kingdom

VIF: Variance Inflation Factor

WHO: World Health Organization

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Abstract

Background: Antenatal mental illness and/or reduced quality of life (QoL) during pregnancy have been identified as risk factors for a woman to experience adverse pregnancy and birth outcomes. Evidence has shown that social support is recommended to reduce the risk of mental health problems and improve QoL during pregnancy. However, the magnitude and direction of the association between social support and antenatal mental health problems and QoL remain inconsistent and under-researched. Therefore, this study aimed to examine low social support and its association with mental health problems and QoL among pregnant Australian women.

Method: This study comprised three interrelated projects. Project 1 involved a systematic review and meta-analysis of literature addressing the relationship between low social support and antenatal mental health problems. Project 2 involved secondary analyses of data obtained from survey six of the 1973–78 Australian Longitudinal Study on Women's Health (ALSWH) cohort (n= 493 pregnant women) examining the prevalence and determinants of low social support and the association between social support and antenatal depression, anxiety as well as HRQoL. Project 3 involved analyses of the relationship between marital status and the risk of antenatal mental health disorders using data obtained from a NSW linked data project (n= 598,599). Meta-analysis and narrative synthesis was used to analyse the systematic review and meta-analysis. For the secondary data, a combination of cross-sectional data analysis was employed, involving descriptive analyses, chi-square tests, logistic regression modelling, mediational analysis and quantile regression (QR).

Results: The systematic review and meta-analyses highlighted that globally, the adjusted odds of antenatal depression and anxiety was 1.18 (95% CI: 1.01, 1.41) and 1.97 (95% CI: 1.34, 2.92) times higher among pregnant women with low social support compared to those with high social support. In addition, of the 22 articles included in the narrative analysis, 20 reported a statistically significant relationship between low social support and antenatal mental health problems (i.e. depression, anxiety, and self-harm).

The ALSWH data analyses found that the prevalence of low social support was 7.1% (n=35). In addition, being non-partnered (AOR = 4.4, 95% CI: 1.27, 14.99), having difficulty managing available income (AOR = 3.1, 95% CI: 1.18, 8.32), experiencing depressive symptoms (AOR = 8.5, 95% CI: 3.29, 22.27) and anxiety symptoms (AOR = 2.9, 95% CI: 1.26, 7.03) were statistically significant determinants of low emotional support. Depressive symptoms (AOR = 5.3, 95% CI: 1.59, 17.99), anxiety symptoms (AOR = 6.9, 95% CI: 2.21, 22.11) and being

moderately/very stressed (AOR = 3, 95% CI: 1.17, 7.89) had statistically significant associations with low affectionate support/positive social interaction. Further, difficulty managing available income (AOR = 3, 95% CI: 1.29, 6.95) and being depressed (AOR = 2.8, 95% CI: 1.48, 5.34) had statistically significant associations with low tangible support.

Analyses of the ALSWH data also indicated that the odds of antenatal depressive symptoms was about five and threefold higher among pregnant women who reported low emotional/informational support (AOR = 4.75; 95% CI: 1.45, 15.66; p = 0.010) and low overall social support (AOR = 3.26, 95%CI: 1.05, 10.10, p = 0.040) respectively, compared with their counterpart. In addition, the odds of antenatal anxiety symptoms was over seven times higher among pregnant women who reported low affectionate support/positive social interaction (AOR = 7.43; 95%CI: 1.75, 31.55; p = 0.006). In addition, the mediational analyses conducted using ALSWH data found that emotional/informational support has a partial mediating effect on the relationship between perceived stress and antenatal depressive symptoms (β = 0.371, 95%CI: 0.067, 0.799) and the relationship between perceived stress and antenatal anxiety symptoms (β = 0.217, 95% CI: 0.029, 0.462).

Further, another mediational analysis conducted using ALSWH data found that emotional/informational support (β = -1.53; 95% CI: -2.36, -0.78), tangible support (β = -0.64; 95% CI: -1.29, -0.09), and affectionate support/positive social interaction (β = -1.33; 95% CI: -2.25, -0.48), played a significant mediating role in the relationship between perceived stress and mental health-related quality of life (QoL). The multivariate quantile regression (QR) analysis indicated that all the domains of social support, as well as overall social support scores, were positively associated with higher MCS scores ($p<0.05$). However, social support was found to have no significant association with PCS ($p> 0.05$).

Finally, analyses of data from NSW-linked health administrative data found that non-partnered pregnant women had a higher likelihood of depressive disorder (Adjusted Odds Ratio (AOR) = 2.75; 95% CI: 2.04, 3.70) and anxiety disorder (AOR = 3.16, 95% CI: 2.03, 4.91), compared with partnered women. Furthermore, the likelihood of experiencing self-harm was two times higher among non-partnered pregnant women (AOR = 2.00; 95% CI: 1.82, 2.20) than among partnered pregnant women.

Conclusion: Low social support was significantly associated with antenatal depression, anxiety and self-harm. Having antenatal mental health problems, being stressed, being from low socio-economic status and being non-partnered were significant determinants of low social support during pregnancy. Emotional/informational support appears to mediate the relationship

between perceived stress and antenatal depression, as well as between perceived stress and antenatal anxiety symptoms. Social support plays a direct and mediating role in improving the HRQoL of pregnant Australian women. Non-partnered marital status has a significant positive association with antenatal depressive disorder, anxiety disorder and self-harm. Policy-makers and those working in maternity care should consider the development of targeted community based social support programs to help reduce mental health problems amongst pregnant women. Further, it would be highly beneficial for maternal healthcare professionals to screen pregnant women for antenatal depression, anxiety, and self-harm and link those screened positive for treatment through appropriate referral pathways.

Articles published or submitted to a journal

I would like to confirm that with my contribution as a first and corresponding author, we have finalised the following articles:

Published articles

1. **Bedaso, A**., Adams, J., Peng, W., & Sibbritt, D. (2021). The relationship between social support and mental health problems during pregnancy: a systematic review and meta-analysis. *Reproductive health*, *18*(1), 1-23. https://doi.org/10.1186/s12978-021-01209-5.

2. **Bedaso, A**., Adams, J., Peng, W., & Sibbritt, D. (2021). Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study. *Reproductive health*, *18*(1), 1-11. https://doi.org/10.1186/s12978-021-01210-y.

3. **Bedaso, A**., Adams, J., Peng, W., & Sibbritt, D. (2021). The association between social support and antenatal depressive and anxiety symptoms among Australian women. *BMC Pregnancy and Childbirth*, *21*(1), 708. https://doi.org/10.1186/s12884-021-04188-4.

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1. **Tilahune, A**., Peng, W., Adams, J., & Sibbritt, D. (2022). The association between social support and antenatal depressive and anxiety symptoms among Australian women. *European Psychiatry, 65*(S1), S211-S211. doi:10.1192/j.eurpsy.2022.551.

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4. **Bedaso, A**., Adams, J., Peng, W. Does social support mediate the relationship between stress and antenatal depression/anxiety? Australian Public Health Conference, 23-24 September 2021, Virtual Conference.

5. **Bedaso, A**., Adams, J., Peng, W. Social support and antenatal mental health problems: a systematic review and meta-analysis. 21st WPA World Congress of Psychiatry, Virtual Congress, Columbia, 18-21 October 2021.

6. **Bedaso, A**., Adams, J., Peng, W. Does social support mediate the relationship between stress and antenatal depression/anxiety? 21st WPA World Congress of Psychiatry, Virtual Congress, Columbia, 18-21 October 2021.

Media Coverage

1. Social support during pregnancy (findings from our systematic review and meta-analysis). Available at: https://www.uts.edu.au/about/faculty-health/news/social-support-during pregnancy.

2. The importance of social support during pregnancy (based on analysed data from ALSWH): Available at:

   2.1 The importance of social support during pregnancy: available at: https://www.scimex.org/newsfeed/the-importance-of-social-support-during-pregnancy. https://www.uts.edu.au/news/health-science/importance-social-support-during-pregnancy.

   2.2 Targeted antenatal screening for social support 'essential': available at: https://www1.racgp.org.au/newsgp/clinical/targeted-antenatal-screening-for-social-supports-e.

   2.3 Why social support is crucial to improved maternal and child health: Available at: https://rwandatoday.africa/rwanda/lifestyle/why-social-support-is-crucial-to-improved-maternal-child-health-3672926.

Additional publications during candidature but not part of this thesis

During my candidacy, I have also published 20 articles as an additional activity.

1. Mengesha T., **Bedaso, A**., Berhanu E., Yesuf A., Duko B., (2023). Prevalence and correlates of depressive symptoms among prisoners in Kaliti federal Prison in Ethiopia: A facility-based cross-sectional study, BMJ Open, http://dx.doi.org/10.1136/bmjopen-2022-061547.
2. Bayes, J., **Bedaso, A**., Peng, W., Adams, J., Sibbritt, D., (2023). The effect of Polyphenols in Post Stroke Adults: A Systematic Review of Randomised Controlled Trials. Clinical Nutrition ESPEN. https://doi.org/10.1016/j.clnesp.2023.01.013.
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5. Mekonnen, N., Duko, B., Kercho, M. W., & **Bedaso, A**. (2022). PTSD among road traffic accident survivors in Africa: A systematic review and meta-analysis. *Heliyon*, *8*(11), e11539. https://doi.org/https://doi.org/10.1016/j.heliyon.2022.e11539.
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11. **Bedaso, A**., Mekonnen, N., & Duko, B. (2021). Estimate of the prevalence of depression among older people in Africa: a systematic review and meta-analysis. Aging & Mental Health, 1-11. doi:10.1080/13607863.2021.1932740.
12. Kinyoki, D., Osgood-Zimmerman, A.E., Bhattacharjee, N.V. **Bedaso A,** et al. Anemia prevalence in women of reproductive age in low- and middle-income countries between 2000 and 2018. Nat Med **27,** 1761–1782 (2021). https://doi.org/10.1038/s41591-021-01498-0.
13. Duko, B., **Bedaso, A**. & Ayano, G. The prevalence of depression among patients with tuberculosis: a systematic review and meta-analysis. Ann Gen Psychiatry **19,** 30 (2020). https://doi.org/10.1186/s12991-020-00281-8.
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15. **Bedaso, A**., Ayalew, M., Mekonnen, N., Duko, B., Global Estimates of the Prevalence of Depression among Prisoners: A Systematic Review and Meta-analysis, Depression Research and Treatment, vol. 2020, Article ID 3695209, 10 pages, 2020. https://doi.org/10.1155/2020/3695209.
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17. **Bedaso A**, Abraham Y, Temesgen A, Mekonnen N. Quality of sleep and associated factors among people living with HIV/AIDS attending ART clinic at Hawassa University comprehensive specialised Hospital, Hawassa, SNNPR, Ethiopia. PLoS One. 2020 Jun 4; 15(6):e0233849. doi: 10.1371/journal.pone.0233849. PMID: 32497153; PMCID: PMC7272010
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20. **Bedaso, A**., Kediro, G., Ebrahim, J. et al. Prevalence and determinants of post-traumatic stress disorder among road traffic accident survivors: a prospective survey at selected hospitals in southern Ethiopia. BMC Emerg Med **20,** 52 (2020). https://doi.org/10.1186/s12873-020-00348-5.

Chapter 1: Introduction

This Chapter provides summarised evidence on the definition, source and type of social support, as well as the possible mechanism of action for social support. The Chapter also describes the epidemiology of antenatal mental health problems, antenatal quality of life and their association with social support. Note that throughout this thesis, antenatal mental health problems refer to antenatal depression, anxiety and self-harm. Finally, this Chapter presents the research significance, aim and structure of the thesis.

The definition of social support and types of social support during pregnancy

Most women experience emotional changes during pregnancy, as well as changes in physical appearance, role, and lifestyle (Davalos et al., 2012; Smith et al., 2011). In addition, these changes may affect a pregnant woman's attitude, decision-making ability, and behaviour when carrying out the responsibilities associated with pregnancy (Sabroza et al., 2004). A lack of social support may aggravate these changes during the antenatal period (Brown et al., 2011; Diego et al., 2006; Divney et al., 2012). Therefore, social support during pregnancy is crucial for overcoming these pregnancy-related challenges (Da Costa et al., 2000).

Social support is broadly categorised into structural support and functional support. Structural support refers to the number and types of social connections within a person's social network (e.g., relationship status or size of social support network) (DiMatteo, 2004). For pregnant women, a spouse is one of the sources of emotional and tangible support (Eaton, 1978). As a result, partnered women have immense psychosocial advantages compared to single or divorced women, although much of this may be limited to women living in stable relationship status (Kaplan & DeLongis, 1983).

Functional social support comprises practical support provided by an individual's available social support network (e.g., emotional, informational, tangible, or affectionate support) (DiMatteo, 2004). Functional social support also refers to providing available resources, such as psychological support and other material support by the social network, to enhance a person's stress-coping ability (Morelli et al., 2015). Broadly, functional social support is also defined as the provision of emotional, informational, instrumental, tangible, and affectionate support by the available social support networks, including family members, friends, or other members of a community (Cohen et al., 2004).

Emotional support is showing care, love and empathy for an individual through verbal or non-verbal communication (Morelli et al., 2015). Informational support involves the provision of guidance, advice, and information to enhance an individual's decision-making ability (Ko et al., 2013). Instrumental or tangible support provides a specific material or instrument for a person who needs it (Morelli et al., 2015). Affectionate support involves the expression of affection and love to help a person feel motivated and cope with stress (Cohen et al., 2004). The overall classification of social support is presented in figure 1 below.

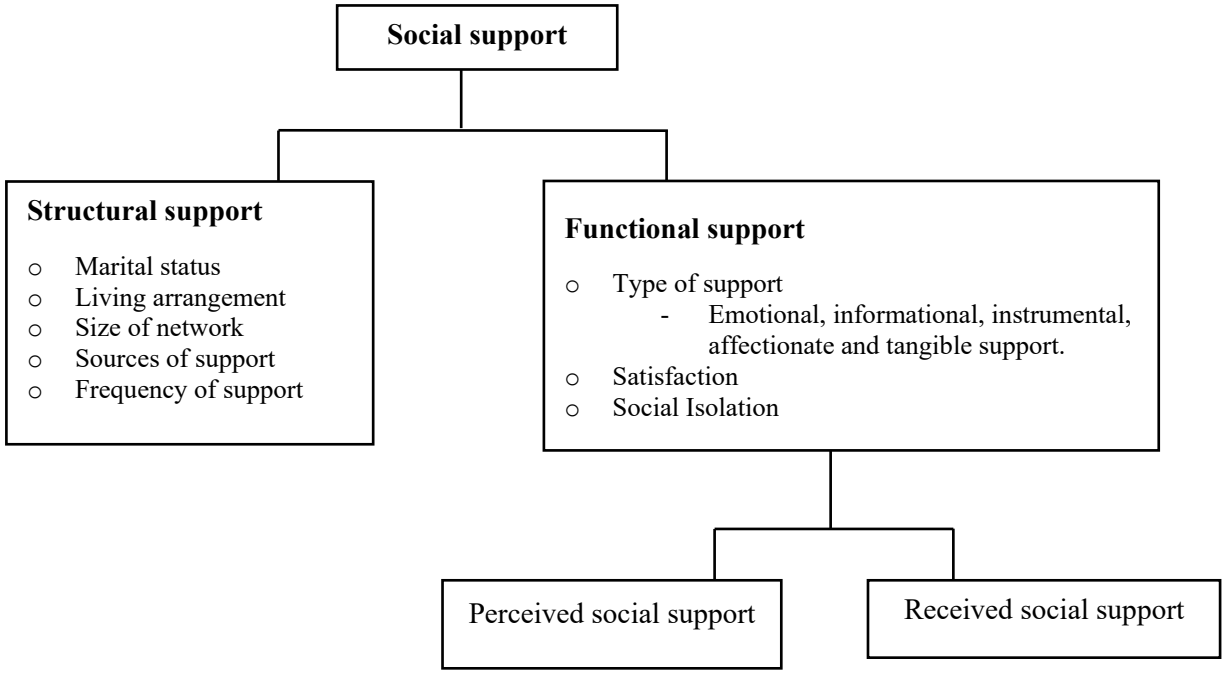


Figure 1.1: Showing the classifications of social support.

Importance and factors affecting social support during pregnancy

Social support helps improve individuals' emotional and physical well-being (Feldman et al., 2000). Social support also enhances social relationships, promotes health (Cohen et al., 2000), and improves the stress-coping ability of pregnant women (Giesbrecht et al., 2013; Rini et al., 2006). Moreover, social support can increase self-confidence, improve infection resistance by enhancing immunity, and lead to a healthier lifestyle (Landman-Peeters et al., 2005; Solar & Irwin, 2007). Further, social support can decrease functional impairment in depressed individuals, enhance recovery and improve quality of life (QOL) (Da Costa et al., 2006; Robertson et al., 2004). It has been evidenced that social support also plays a role in preventing adverse birth outcomes (Glazier et al., 2009; Zachariah, 2009). Published studies over the past three decades have shown that individuals getting social support have better longevity than those without social support in the general population (Orr, 2004).

In contrast, studies conducted in Japan and US reported that low social support is a risk factor for antenatal and postnatal depression (Morikawa et al., 2015; Spoozak et al., 2009; Werner et al., 2015), as well as a risk factor for the birth of underweight infants (Theo Mutale et al., 1991). There is also a link between low social support and the risk of antenatal alcohol drinking, tobacco smoking, and the use of illicit drugs (Degen et al., 1993; Dunnagan et al., 2003; Shishehgar et al., 2013). Moreover, pregnant women with anxiety disorder, who smoke tobacco, who are non-partnered, and those with a low socio-economic status report low social support (Peter et al., 2017). Low level of education and non-partnered relationship status are also significant factors associated with low social support during the antenatal period (Emmanuel et al., 2011).

Studies found that pregnant women with divorced or single marital status have a higher rate of depression (Fadzil et al., 2013; Gemta, 2015; Mossie et al., 2017), anxiety (Fadzil et al., 2013) and suicide (da Silva et al., 2012) than married pregnant women. A study conducted in Victoria, Australia, reported that single pregnant women experienced a higher level of depression than those with unsupportive partners (Bilszta et al., 2008). However, married pregnant women living in poor-quality relationships also have a higher risk of mental health problems (Biaggi et al., 2016). The higher risk of antenatal mental health problems might be because those pregnant women living in a violent marriage are exposed to additional stress from their partner, which might lead to anxiety and adverse birth outcomes (Bailey, 2010; Hamberger & Arnold, 1990). A published review of longitudinal studies based in Australia and New Zealand have shown that poor partner relationship as the main predictor of anxiety and depression during pregnancy (Schmied et al., 2013).

Epidemiology of antenatal mental health problems

Globally, numerous epidemiological studies have determined the prevalence of antenatal mental health problems. Depression (Rich-Edwards et al., 2006), anxiety (Dunkel Schetter, 2011) and self-harm (Say et al., 2014) are among the most prevalent antenatal mental health problems.

According to the 5th edition (DSM–V) Diagnostic and Statistical Manual of Mental Disorders (Lipton et al., 2016) and the 11th revision (ICD-11) International Statistical Clarification of Disease (Innes et al., 1997), depression is characterised by symptoms such as depressed mood or loss of interest or pleasure for at least two weeks. Depressive symptoms are also complemented by feelings of fatigue, worthlessness, poor appetite, trouble sleeping, poor concentration, low self-esteem or suicidal ideation (Kastrup & Ramos, 2007). An international

review found the global prevalence of antenatal depression ranges from 15% to 65% (Fekadu Dadi et al., 2020). The pooled estimate of antenatal depression was higher in low and middle-income countries (34%) (Fekadu Dadi et al., 2020) compared to high-income countries (17%) (Roomruangwong & Epperson, 2011).

In European countries, the reported prevalence of antenatal depression ranges from 13.2% to 21.9% (Agostini et al., 2015; Gawlik et al., 2013; Giardinelli et al., 2012; Hain et al., 2016; Matteo et al., 2012; Shakeel et al., 2015). The lowest and highest estimates were reported in Italy (21.9%) (Giardinelli et al., 2012) and Germany (13.2%) (Hein et al., 2014). In high-income Asian countries, the reported prevalence of antenatal depression ranges from 11.9% to 24.3% (Al-Azri et al., 2016; Dmitrovic et al., 2014; Fadzil et al., 2013; Glasser et al., 2016; Jeong et al., 2013; Miyake et al., 2015). The reported prevalence of antenatal depression by studies conducted in Australia ranges from 6% to 16.9% (Buist et al., 2006; Eastwood et al., 2017; Leigh & Milgrom, 2008; Ogbo et al., 2018). The possible reason for the variation in estimates across countries could be socio-economic and cultural differences and the use of different measurement tools.

Antenatal anxiety is defined as an excess of worries about pregnancy, the birth of the child, the health of the infant and future parenting roles (Huizink et al., 2004). A global-level meta-analysis found that the pooled prevalence of antenatal anxiety ranged from 34.4% in LMICs to 19.4% in high-income countries (Dennis et al., 2017). Based on the reports of epidemiological studies conducted in Australia, the estimates of antenatal anxiety range between 14% to 59% (Faisal-Cury & Menezes, 2007; Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Serçekuş & Okumuş, 2009; Teixeira et al., 2009). The prevalence of antenatal self-harm ranges from 5% to 14% in a report of an international review (Lindahl et al., 2005). Studies conducted in Australia (Giallo et al., 2018) and South Africa (Redinger et al., 2021) have estimated the prevalence of self-harm during pregnancy to be 5% and 18%, respectively.

Based on reports of different published studies, the significant risk factors for antenatal depression include stress, low social support, anxiety, history of abuse, and low income (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018), domestic violence (Edwards et al., 2008), unplanned pregnancy and history of any mental illness (Biratu & Haile, 2015; Bisetegn et al., 2016). The significant factors associated with antenatal anxiety include loss of previous pregnancy (Bogaerts et al., 2013; Gong et al., 2013; Woods-Giscombé et al., 2010), stress (Bayrampour et al., 2015), abuse during the pregnancy period (Agrati et al., 2015; Bayrampour et al., 2015; Buist et al., 2011), history of mental illness (Bayrampour et al., 2015;

Buist et al., 2011; Byatt et al., 2014; Fadzil et al., 2013), substance abuse (Arch, 2013; Bayrampour et al., 2015; Bogaerts et al., 2013; Rubertsson et al., 2014), drinking alcohol (Arch, 2013), food insecurity, unplanned pregnancy (van Heyningen et al., 2017), poor quality relationship with marital partner and low social support (Biaggi et al., 2016).

Antenatal mental health problems are associated with adverse obstetric and foetal outcomes, resulting in a higher rate of pregnancy complications and postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995). Untreated antenatal anxiety and depression could lead to postnatal depression and impaired mother-infant interaction (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004). The 2019 Australian health-economic analysis report on the impact of antenatal depression and anxiety estimated $877 million cost to the health system, economy and well-being of those impacted (PricewaterhouseCoopers, 2019). The Australian Productivity Commission's 2020 Mental Health Report also estimates the cost of improving perinatal mental health at an additional $18-23 million in direct expenses to manage cases (ProductivityCommission, 2020). Therefore, to reduce these adverse effects, providing social support during pregnancy plays a vital role (Da Costa et al., 2000).

Quality of life during pregnancy and its relationship with social support

Quality of life (QoL) is defined as an *"individual's perception of their physical and mental health, level of independence, social relationships, personal beliefs, as well as their relationships to their environment"* (World Health Organization, 1997). The hormonal and physiological changes during pregnancy (Alzboon & Vural, 2019) and antenatal exposure to stressful events could adversely affect the mental and physical health of pregnant women, which will most likely worsen their quality of life (QoL) (Calou et al., 2014). Health-related quality of life (HRQoL) is a sub-component of QoL and refers to a value given to the duration of life as altered by one's functional ability and disability, perceptions, and social opportunities resulting from body changes, illness, injury, or treatment (Patrick & Erickson, 1993).

Evidence has shown that poor HRQoL during pregnancy is associated with increased gestational weight gain (Altazan et al., 2019), low birth weight infants (LBW) (Lau, 2013; Wang et al., 2013), fatigue, back and pelvic pain (Bai et al., 2018), and low HRQoL in the postnatal period (Fobelets et al., 2018). Pregnant women frequently experience stress (Woods et al., 2010), which can substantially affect HRQoL (Lau & Yin, 2011; Shishehgar et al., 2014). Epidemiological studies have shown the prevalence of stress during pregnancy ranges from

12% to 36.1% in Canada (Kingston et al., 2012; Whitehead et al., 2003), 78% in the US (Woods et al., 2010) and 95% in China (Tang et al., 2019). A longitudinal study conducted in Australia reported that the highest stress level was observed in the early and late stages of pregnancy. During these stages, pregnant women experience morning sickness in the first trimester and the baby gets bigger in the third trimester, which causes pain and discomfort and puts more stress on the body (Rallis et al., 2014). Stress may also aggravate gestational diabetes mellitus (DM) and preeclampsia, negatively affecting the HRQoL (Danyliv et al., 2015; Hoedjes et al., 2011).

It was evidenced that providing social support can reduce stress, decrease functional impairment, and enhance recovery, thus improving the HRQoL during pregnancy (Da Costa et al., 2006; Robertson et al., 2004). It has been recommended that social support can effectively reduce the risk of antenatal and neonatal adverse birth outcomes by minimising the impact of stress on pregnant women's mental and physical well-being (Glazier et al., 2009; Zachariah, 2009).

Possible explanations for the association between social support and mental health problems and quality of life during pregnancy

Several plausible explanations have been suggested for the association between low social support, antenatal mental health problems, and quality of life during pregnancy. Pregnant women with low social support may have no one to confide in and obtain necessary information, advice or help from to reduce the negative emotions associated with stressful events, and as a result, they may become stressed and subsequently develop mental health problems (Thoits, 1986). Further, pregnant women with low social support are less satisfied with their family and interact poorly with the social environment, making them prone to loneliness, reducing their ability to cope with stressful events, and developing mental health problems (Alden & Mellings, 2004; Thoits, 1986). Also, non-partnered pregnant women lack one of the important sources of emotional and tangible support, which might lead to poor stress coping and the risk of mental health problems during pregnancy (Eaton, 1978). However, married pregnant women living in poor-quality relationships with their spouses also appear to be at greater risk of antenatal mental health problems (Biaggi et al., 2016; Gourounti et al., 2014; Nasreen et al., 2011) because of the exposure to additional stress from their spouse (Hamberger & Arnold, 1990).

In addition, a lack of social support can prevent pregnant women from accessing help and other services from the social support network (Li et al., 2018), which can aggravate mental health

problems and HRQoL. Further, pregnant women with inadequate social support pay less attention to pregnancy-related changes, which could discourage them from participating in good pregnancy care practices (Mabetha et al., 2022). Evidence has also shown that low social support strongly predicts health risk factors such as increased alcohol intake, decreased physical activity (Croezen et al., 2012), and high body mass index (BMI) (Moak & Agrawal, 2010), which can all reduce HRQoL.

There are two hypotheses for the social support mechanism of action in preventing mental health problems and improving QoL (i.e., through main/direct effect and buffering hypothesis). As a direct effect hypothesis, social support offers a sense of belonging and stability, leading to increased self-esteem, reduced risk of stress and subsequent mental illness, and enhanced QoL (Cohen & Wills, 1985). As a stress-buffering role, social support can provide resources to improve the stress-coping mechanism for pregnant women (Cohen & Wills, 1985; Dunkel Schetter, 2011).

However, only limited studies have assessed the relationship between social support and mental health problems and quality of life during pregnancy. Further, within these limited studies, inconsistent associations have been reported. Thus, there are important knowledge gaps that need to be addressed to fully comprehend these associations. Most of the prior studies considered overall social support rather than specific domains of social support while examining its association with antenatal mental health problems and HRQoL. Moreover, most studies reporting significant association were with limited confounder adjustment. No previous research has studied the mediating effect of social support in the linkage between perceived stress and antenatal mental health problems as well as HRQoL. Similarly, no studies have assessed the relationship between marital status and the risk of antenatal mental health problems using linked data.

Therefore, to address these knowledge gaps, the current thesis examined the relationship between social support and mental health problems as well as the quality of life during pregnancy among Australian women. Also, this thesis aimed to assess the association between non-partnered relationship status and the risk of antenatal depressive disorder, anxiety disorder, and self-harm using New South Wales (NSW) linked health administrative data. The hypothesis examined was that pregnant mothers with low social support are more likely to develop antenatal mental health problems and reduced HRQoL. Another hypothesis examined was that non-partnered marital status is significantly associated with antenatal depressive disorder, anxiety disorder and self-harm.

Research aim and question

Research Aim

The main aim of the study was to examine the prevalence and determinants of low social support and its association with mental health and quality of life of Australian pregnant women.

Research question

In order to address the above research aim, the study seeks to answer the following seven research questions:

1. What is the association between social support and depression, anxiety and self-harm during pregnancy (by systematically reviewing previous epidemiological studies on the topic)?
2. What is the prevalence and determinants of low social support among Australian pregnant women?
3. What is the association between social support and antenatal depression and anxiety among Australian women?
4. What is the association between relationship status (marital partner as a source of support) and the risk of antenatal mental disorders (depression, anxiety and self-harm)?
5. Does social support mediate the relationship between perceived stress and depression, and anxiety during pregnancy among Australian women?
6. What is the association between social support and HRQoL among Australian pregnant women?
7. Does social support mediate the relationship between perceived stress and HRQoL during pregnancy among Australian women?

Significance of the study

In Australia, from published studies, the prevalence of antenatal depression ranges from 6% to 16.9% (Buist et al., 2006; Eastwood et al., 2017; Leigh & Milgrom, 2008; Ogbo et al., 2018), and antenatal anxiety range between 14% to 59% (Faisal-Cury & Menezes, 2007; Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Serçekuş & Okumuş, 2009; Teixeira et al., 2009), and 5% antenatal self-harm (Giallo et al., 2018). Antenatal mental health problems affect obstetric and foetal outcomes, lead to postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995), and negatively influence a country's social and economic situation (Heazell et al., 2016). Evidence also shows

that QoL during pregnancy may be deteriorated due to hormonal and physiological changes (Alzboon & Vural, 2019), as well as different stressful events (Calou et al., 2014). Therefore, to reduce these adverse effects, providing social support during pregnancy plays a vital role (Da Costa et al., 2000).

Social support can decrease stress, reduce functional impairment among individuals with antenatal mental health problems, and increase the likelihood of recovery, thereby improving the overall quality of life (QOL) (Feldman et al., 2000). Globally, a limited number of studies have examined the association between social support and antenatal mental health problems, as well as HRQoL. Pregnant women receiving low social support may have a higher risk of antenatal mental health problems and decreased HRQoL than those receiving high social support. Existing evidence also suggests the risk of antenatal mental health problems and reduced HRQoL differ by the level and types of social support. However, some of the findings from the previous studies report inconsistent and less precise magnitude of associations due to different methodological issues (e.g., low statistical power due to small study sample size and varying confounder adjustment).

Further, most of the previous studies considered overall social support rather than specific domains of social support while examining its linkage with antenatal mental health problems and HRQoL. In addition, no previous research has studied the mediating effect of the domains of social support in the link between perceived stress and antenatal mental health problems and HRQoL. Similarly, there has also been a lack of studies examining the linkage between relationship status and the risk of antenatal mental health problems using linked data, which would create opportunities for more complex and expanded research.

Therefore, this study will address this knowledge gap in the current literature, and the findings will provide a greater understanding of the relationship between social support and wellbeing during pregnancy and inform the development of appropriate initiatives. In addition, researchers in the field will be able to use the result of this study to design future longitudinal and experimental studies to examine the causal link between social support and prenatal mental health problems and HRQoL.

The structure of the Thesis

This thesis has ten chapters. Chapter one highlights background information on the existing studies related to the current topic, including an overview of social support and its association

with antenatal mental health problems and quality of life. The introduction section also provided an overview of the global and national burden of antenatal mental health problems and quality of life during pregnancy.

Chapter Two starts with a review of social support and its determinants during pregnancy. A summary of the burden of antenatal mental health problems is also highlighted in this Chapter. This Chapter also detailed the findings of studies examining the association between social support and HRQoL and significant determinants of antenatal HRQoL.

Chapter Three thoroughly describes the study design, study participants, data source, the measures used, and the statistical analyses employed.

Chapter four to eight contain the study findings from four manuscripts published in peer-reviewed journals. Also, one study finding, which is currently under review in a journal, is presented in Chapter nine.

The included articles examined the following topics:

1. The relationship between social support and mental health problems during pregnancy: a systematic review and meta-analysis (Chapter four).
2. Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study (Chapter five).
3. The association between social support and antenatal depressive and anxiety symptoms among Australian women (Chapter six).
4. An examination of the association between marital status and antenatal mental disorders using linked health administrative data (Chapter seven).
5. The mediational role of social support in the relationship between stress and antenatal anxiety and depressive symptoms among Australian women: a mediational analysis (Chapter eight).
6. The direct and mediating effect of social support in the relationship between perceived stress and quality of life during pregnancy among Australian Women (Chapter nine).

Chapter ten summarises and discusses the major study findings, highlights the implications of the result, and finally provides strengths and limitations.

Chapter eleven provides the overall conclusion of the thesis.

Important documents, such as the supplementary file for each Chapter, are attached as appendices, following the list of references.

Chapter Summary

This Chapter provided an overview of social support during pregnancy, HRQoL and the burden of antenatal mental health problems. The Chapter also detailed the mechanism of the relationship between social support and antenatal mental health problems and HRQOL. Further, the research aim, significance and structure of the thesis were highlighted in this Chapter.

The next Chapter covers the literature review of international studies focusing on the association between low social support and antenatal mental health problems, the burden of antenatal mental health problems, the determinants of social support and the link between social support and HRQoL.

Chapter 2: Literature Review

This Chapter provides insight into social support during pregnancy, the burden of antenatal mental health problems, the linkage between social support and antenatal mental health problems, and HRQoL. This Chapter also provides an overview of the determinants of social support and the relationship between social support and HRQoL. Also, the Chapter presented an overview of studies that have examined various associations between antenatal social support and antenatal mental health or quality of life. An overview of these studies is presented below.

2.1 Social support during pregnancy

As detailed in Chapter four (Table 4.2) of the thesis, there were around 22 social support measures globally. From these social support measures, the 3-item Oslo social support scale (OSSS-3) (Dalgard et al., 2006), the Multidimensional Scale of Perceived Social Support (MSPSS) (Hatton et al., 2007), the Maternal Social Support Index (MSSI) (Pascoe et al., 1988) and the Medical Outcome Study Social support scale (MOS-SSS) were the most widely used tools (Sherbourne & Stewart, 1991). This shows a difference in understanding social support across individuals with different socio-economic settings. The lack of comprehensive agreement regarding the best method to measure social support is one of the challenges in the current literature (Berkman, 2000).

Despite the heterogeneity across social support measures, some studies in Australia examined social support during pregnancy and reported the prevalence of low social support. For instance, in a study conducted at the Royal Women's Hospital in Brisbane (n= 990), 28.4% of pregnant women reported poor social support (Webster et al., 2000). The study examined social support using a self-reported six-item maternity social support scale and classified social support as high/low based on the average total score (Webster et al., 2000). In another Australian study using a sample of 600 pregnant women, the prevalence of low perceived social support was 11% (Spry et al., 2021). The study participants were between the age of 29–35 years, used Maternity social support scale, and defined low social support as an overall mean score ≤ 10th percentile (Spry et al., 2021).

A review of the current literature has identified significant determinants of social support during pregnancy. For instance, a facility-based cross-sectional study conducted in Southern Brazil (n=871) in a sample of pregnant women found that pregnant women with lower educational status; non-partnered marital status; age range of 18 to19 years; an unplanned

pregnancy; gestational risk; tobacco smoking; and/or an anxiety disorder reported less social support in the domains of the medical outcomes study (MOS) social support survey (Peter et al., 2017). A cross-sectional study conducted in Mexico (n = 918) revealed that a higher household income predicts greater perceived social support (Palomar Lever & Cienfuegos Martínez, 2007). A cross-sectional study conducted in the US (n=198) to explore the social determinants of partner support during pregnancy found that married women had more support than unmarried ones (Cohen et al., 2014). Also, women with a household income of $0–20,000 had less partner support than those with an income of >$100,000 ($p < 0.001$). Women with a high school diploma or less had lower support scores than those with a degree graduate ($p = 0.01$) (Cohen et al., 2014).

A comparative study conducted among Swedish pregnant teenage girls aged 15-19 (n=97) reported that teenage mothers had higher odds of getting low social support compared with adult mothers aged 25-29 years (n=97) (OR: 7.27, 95% CI (1.7, 16.5)) (Wahn & Nissen, 2008).

An important knowledge gap identified in the current literature was that no national studies (i.e., women participated in the study from all states of Australia) were conducted in Australia determining the prevalence and factors associated with low social support during pregnancy, which is essential to set a strategy to strengthen maternal social support during pregnancy.

2.3 Burden of antenatal mental health problems

The common mental health problems women experience during pregnancy include anxiety (Dunkel Schetter, 2011) and depression (Rich-Edwards et al., 2006). Depression is characterised by a depressed mood, low self-esteem, loss of interest, feelings of worthlessness, loss of appetite, feelings of fatigue, and poor concentration (Kastrup & Ramos, 2007). An umbrella review examining the global prevalence of antenatal depression reported a 15% to 65% prevalence in low- to middle-income countries and a 17% pooled prevalence of antenatal depression in high-income countries based on ten identified systematic reviews (Dadi, Miller, Bisetegn, et al., 2020). Australian studies have reported a higher prevalence of antenatal depression, from 6% (Buist et al., 2006; Eastwood et al., 2017) to 17% (Leigh & Milgrom, 2008). A study conducted in South Australia among economically disadvantaged pregnant women reported that antenatal depression was 30% (Edwards et al., 2008).

Based on reports of several studies, determinants of antenatal depression include low self-esteem, anxiety, lack of social support, negative cognitive style, major life events, low income, and history of abuse (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018),

domestic violence during pregnancy (Edwards et al., 2008), being from the culturally and linguistically diverse (CALD) background (Ogbo et al., 2018), having an unplanned pregnancy, having a personal or family history of any mental disorder or stress (Biratu & Haile, 2015; Bisetegn et al., 2016), and being a housewife (Ayele et al., 2016; Mossie et al., 2017).

Antenatal anxiety is defined as excess concerns about pregnancy, childbirth, the health of the infant and future parenting roles (Huizink et al., 2004). Individual studies have reported that the prevalence of antenatal anxiety range between 14–59% (Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Teixeira et al., 2009), while meta-analysis conducted on estimating the global prevalence of antenatal anxiety estimated a 34.4% pooled prevalence in low- to middle-income countries and 19.4% in high-income countries (Dennis et al., 2017). Various studies conducted in Australia revealed that the prevalence of antenatal anxiety in Australia ranges between 14% and 59% (Faisal-Cury & Menezes, 2007; Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Serçekuş & Okumuş, 2009; Teixeira et al., 2009).

The significant risk factors of anxiety during pregnancy include a previous pregnancy loss (Bogaerts et al., 2013; Gong et al., 2013; Woods-Giscombé et al., 2010), a history of infertility (Gourounti et al., 2013), stress (Bayrampour et al., 2015), abuse (Agrati et al., 2015; Bayrampour et al., 2015; Buist et al., 2011), a history of mental health problems (Bayrampour et al., 2015; Buist et al., 2011; Byatt et al., 2014; Fadzil et al., 2013), smoking/substance abuse (Arch, 2013; Bayrampour et al., 2015; Bogaerts et al., 2013; Rubertsson et al., 2014), drinking alcohol (Arch, 2013), antenatal depression, food insecurity, unplanned and unwanted pregnancy (van Heyningen et al., 2017) experience of threatening life events (Faisal-Cury & Menezes, 2007; van Heyningen et al., 2017), reporting low social support, and poor quality relationship with a partner (Biaggi et al., 2016).

Antenatal depression and anxiety adversely affect several obstetric and foetal outcomes. If not adequately managed, antenatal depression and anxiety may increase the rate of pregnancy complications and postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995). Untreated antenatal depression may lead to postnatal depression for the mother and may also result in an impaired interaction with her infant (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004). Further, antenatal depression and anxiety are associated with increased risk-taking behaviours such as smoking and abuse of other substances, which will increase a woman's risk for pregnancy complications and may result in a poor quality of life (QOL) (Shapiro et al., 2013; Straub et al., 2014).

2.4 Association between social support and antenatal mental health problems

Epidemiological studies investigated the association between social support and antenatal depression (Clements et al., 2016; Herbell & Zauszniewski, 2019; Huang et al., 2019; Records & Rice, 2007; Verreault et al., 2014; Yanikkerem et al., 2013). Among these studies, some reported a significant relationship between low social support and risk of antenatal depression (Clements et al., 2016; Herbell & Zauszniewski, 2019; Huang et al., 2019; Leigh & Milgrom, 2008; Records & Rice, 2007; Senturk et al., 2011; Verreault et al., 2014; Yanikkerem et al., 2013). However, a cross-sectional study conducted in Jordan reported no evidence of a significant correlation between social support and antenatal depression (Abujilban et al., 2014).

Also, of the studies that examined the association between social support and anxiety during pregnancy, most reported a significant association (Gourounti et al., 2013; Huang et al., 2019; Nasreen et al., 2011) or correlation (Akiki et al., 2016; Glazier et al., 2009; Shafaie et al., 2018; Waqas et al., 2015) between low social support and antenatal anxiety. Conversely, a study conducted in Canada reported no evidence of a significant association between social support and antenatal anxiety (Dunkel Schetter et al., 2016).

Further, a limited number of studies have examined the association between social support and self-harm during pregnancy. For example, a cross-sectional study conducted in South Africa among randomly selected pregnant women reported a significant association between social support and suicidal ideation and behaviour (SIB), suggesting a protective effect of good social support (Onah et al., 2017). A cross-sectional study in Brazil reported that women with low social support were three times more likely to develop self-harm than their counterparts (Pinheiro et al., 2012). Finally, a study conducted in India among urban pregnant women found that those who reported low perceived social support had higher odds of developing current suicidal ideation (n= 462) (Supraja et al., 2016). Nonetheless, a cross-sectional study conducted in Brazil found no significant linkage between social support and self-harm ((e Couto et al., 2016).

The above studies examining the linkage between social support and antenatal mental problems had some limitations. For example, most studies were based on data from a single institution or community. Also, there was some limitation in adjusting for confounders, and more importantly, no studies examined the linkage between the specific domains of social support and antenatal mental health problems. However, no systematic review and/or meta-analysis has been conducted to summarise and critically review findings from individual studies,

making the available evidence more accessible to decision-makers. Also, no global-level evidence on the pooled estimates of the relationship between social support and antenatal mental health problems. As such, the current study conducted a global-level comprehensive systematic review and meta-analysis on the relationship between social support and antenatal mental health problems and presented in Chapter four.

2.5 Association between social support and HRQoL during pregnancy

Available epidemiological studies revealed that pregnant women with low social support might have a significantly reduced HRQoL, but some studies reported a non-significant association (Emmanuel et al., 2012). For example, a cross-sectional study conducted in Brazil among third-trimester pregnant women (n=82) to examine the HRQol of pregnant women with heartburn and regurgitation revealed that social support was significantly associated with QoL ($p<0.05$) (Dall'Alba et al., 2015). Another cross-sectional study conducted in Pakistan (n=120) found that pregnant women who receive social support during pregnancy have a higher level of HRQoL ($r=0.33$, $P<0.01$) (Gul et al., 2018).

In a study conducted in Iran among 341 pregnant women sampled from urban health care centres, it was found that low social support was significantly associated with a low HRQoL. Conversely, these women had significantly better QoL in the group where social support was high (Elsenbruch et al., 2007). A facility-based longitudinal study from US (n=155) reported that social support was not associated with increased physical or emotional well-being among randomly selected Hispanic and black low-risk pregnant women. However, social support was associated with mental health components, as measured by the SF-36 (Mckee et al., 2001).

A cross-sectional study conducted in the US among 175 randomly selected women in early pregnancy found that social support provided by a spouse is significantly associated with several components of the SF-36, including Role-Physical (AOR: 30, 95% CI (6, 55)), General Health (AOR: 9, 95% CI (5, 15)), Social Functioning (AOR: 4, 95% CI (4.6, 3.7)), and Mental Health (AOR: 14, 95% CI (12, 16)). But social support provided by those other than a spouse was not significantly associated with any component of SF-36 (Nicholson et al., 2006). Further, a cross-sectional study conducted in Canada to identify determinants of health-related quality of life (HRQoL) during pregnancy (n=245) found that social support was a significant predictor of the mental health component of SF-36 (QoL) (Da Costa et al., 2010).

However, a longitudinal study conducted in three public hospitals in metropolitan Brisbane, Australia (n=473) to explore demographic and social support predictors of HRQoL of pregnant

women revealed that social support had no significant association with HRQoL during pregnancy (β= 0.21, 95% CI: −0.04,0.47) (Emmanuel et al., 2012). The possible reason for the different finding might be due to demographic factors and instrument employed. For instance, the study by Emmanuel et al. selected pregnant women from three public hospitals in metropolitan Brisbane, Australia, and it employed SF-12 and Maternal Social Support Scale (MSSS) to examine HRQoL and social support, respectively, at 36 weeks of pregnancy and 6 and 12 weeks after giving birth (Emmanuel et al., 2012).

The above studies examining the relationship between social support and antenatal HRQoL had several limitations. For example, most studies had the potential limitation in adjusting for confounders and/or were based on relatively small sample sizes. More importantly, no studies examined the mediational role of social support in the linkage between perceived stress and HRQoL, as well as the link between the specific domain of social support and HRQoL during pregnancy in Australia.

2.5 Factors associated with HRQoL during pregnancy

A facility-based longitudinal study in Taiwan, which recruited a convenience sample of 198 pregnant women, reported that employment, parity, educational level, and happiness about the current pregnancy were factors significantly associated with antenatal HRQoL (Wang et al., 2013). In addition, a longitudinal study from Canada (n=245) found that factors such as age, educational level, sleep problems, depression, pregnancy-related anxiety, stressful life events (Wang et al., 2013), complicated pregnancy, and having a history of medical problems (Da Costa et al., 2010) were significant predictors of lower HRQoL during pregnancy.

A cross-sectional study conducted among 210 Iranian pregnant women found a significant relationship between poor quality of life and increased pregnancy stress levels (Shishehgar et al., 2014). Another cross-sectional study in Iran (n=341) suggested that domestic violence during pregnancy is associated with poor HRQoL (Gharacheh et al., 2016). A longitudinal study conducted in Brazil (n=58) found that pregnant women with low physical activity before pregnancy and in the first trimester had significantly better HRQoL than those women at 19–24 weeks of pregnancy (Tendais et al., 2011). Another cross-sectional study (n=179) among pregnant women attending public health facilities in Southern Brazil reported that women who experienced sexual violence by a family member had significantly lower HRQoL than pregnant women with no history of sexual violence (Aquino et al., 2009).

A prospective cohort study on pregnant women conducted in the US (n=1809) through a telephone survey found that having financial problems, depression, obesity, shortage of physical exercise, smoking tobacco, and a history of alcohol dependence were all significantly related to lower HRQoL (Haas et al., 2005). A community-based, cross-sectional study conducted in the US among a sample of pregnant (n=175) women found that depression, lower income and multi-parity were significant predictors of lower HRQoL (Nicholson et al., 2006). A facility-based, cross-sectional study conducted in England (n=129) revealed that pregnant women with depression and anxiety had significantly lower HRQoL (Jomeen & Martin, 2005).

Conceptual Framework

After reviewing the literature, the conceptual framework for examining the linkage between low social support and antenatal mental health problems was developed and presented in Figure 2.1 below. I hypothesised that after controlling for potential confounders, pregnant mothers with low social support are more likely to suffer from antenatal mental health problems and reduced HRQoL. Another hypothesis examined was that non-partnered marital status is significantly associated with antenatal depressive disorder, anxiety disorder and self-harm.

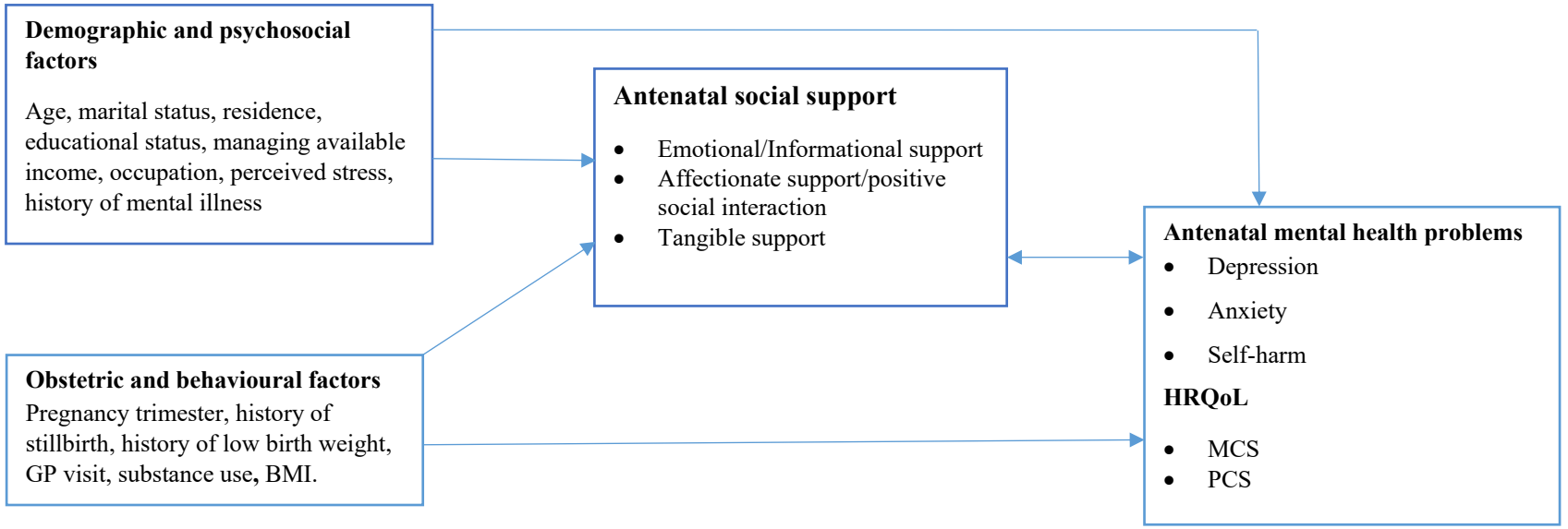


Figure 2.1: Overview of the conceptual framework on the examination of low social support and its linkage with antenatal mental health problems and HRQoL.

Chapter Summary

This Chapter reviewed and summarised the global level literature examining the linkage between social support and antenatal mental health problems, the burden of antenatal mental health problems, determinants of social support and the link between social support and HRQoL. This Chapter also emphasised the available research gap in the association between social support and antenatal mental health problems and HRQoL, and finally, the conceptual framework was indicated.

The next Chapter highlighted the methodology followed to address the research questions of the thesis.

Chapter 3: Methodology

This Chapter summarises the data source, study design, data collection technique, tools used to assess the outcome and exposure variables, analysis method, and ethical considerations. This Chapter also details the two cohorts analysed and reported in this thesis: the Australian Longitudinal Study on Women's Health (ALSWH); and the NSW record linkage project.

3.1 Study design and data source

3.1.1 Systematic review and meta-analysis

For the systematic review and meta-analysis, the PRISMA checklist was used as a guide to systematically review relevant peer-reviewed studies that assessed and reported findings from primary or secondary data. PubMed, Psych Info, MIDIRS, SCOPUS, and CINAHL database searches were conducted to retrieve research articles published English language between the years 2000 to 2019. This systematic review and meta-analysis protocol was registered in PROSPERO (CRD42020155981).

3.1.2 Australian Longitudinal Study on Women's Health (ALSWH)

For the data obtained from ALSWH, cross-sectional data analyses were conducted. ALSWH is a national longitudinal cohort study established to examine factors affecting Australian women's health over 20 years (http://www.alswh.org.au/about/aims). It provides an evidence base to the Australian Government Department of Health and Ageing for the development and evaluation of policy and practice in many areas of service delivery that affect women.

3.1.3 NSW data-linkage project

Data was also obtained from a record linkage project focusing on pregnant women living in the State of New South Wales (NSW), Australia (https://www.cherel.org.au/projects). This population-based study generated a cohort from existing, routinely-collected data from 1 July 2000 to 31 December 2011. To create the cohort used for this PhD study, two datasets were linked, including the NSW Perinatal Data Collection (PDC) and NSW Admitted Patient Data Collection (APDC).

3.2 Participants

3.2.1 Australian Longitudinal Study on Women's Health (ALSWH)

The ALSWH project began in 1996 by recruiting >40,000 women in three different age cohorts (women born between 1973-78, 1946-51 and 1921-26). The data analysed within this thesis was from the 1973-78 cohort, the only cohort containing women of child-bearing age. Study participants were selected randomly (except that women living in rural and remote areas were sampled at twice the rate of women in urban areas) using the national health insurance database and were asked to complete questionnaires at an approximately three-year interval. The age of participant women of the 1973-78 cohort was between 18–23 years when recruited in 1996 and was broadly representative of the population of similar-age Australian women at that time (Lee et al., 2005).

The data for this study was drawn from survey 6 of the 1973–78 ALSWH cohort when the women were aged 34-39 years. From women (n=8010) who completed survey 6 (aged 34-39 years) in 2012, those who reported they were pregnant (n=493) were included in the current analyses.

3.2.2 NSW data-linkage project

For the NSW linked data project, in the APDC (2000-2011), there were 646,233 mothers with 2,624,544 hospital admissions. In the PDC dataset (2000-2011), 649,210 mothers were included with 1,053,819 birth records. After excluding duplicate records, 609,299 mothers from the PDC dataset were linked with 882,238 admissions from the APDC dataset. Then, after excluding those women with no data on marital status, 598,599 pregnant women with 865,349 admissions were included in the analyses.

3.3 Data collection technique

3.3.1 Australian Longitudinal Study on Women's Health (ALSWH)

For the ALSWH data, after the address of residents was taken from the national Medicare database, the ALSWH research team invited a random sample of Australian women to participate. Upon receiving written consent, questionnaires were mailed to these women. Participants were provided with pre-paid envelopes for completing and returning the questionnaires to the ALSWH. Later, the surveys were scanned and saved as images. The images were then processed using optical mark recognition software to capture the data.

3.3.2 NSW data-linkage project

For the NSW linked data, the PDC contained data on all births of at least 20 weeks gestation or at least 400g birthweight. It covers all births in public hospitals, private hospitals, and homebirths in NSW and includes information on maternal characteristics, pregnancy, labour, delivery, and neonatal outcomes. The APDC covers all patient hospitalisations and provides information on patient demographics, diagnoses, and clinical procedures. The Centre for Health Record Linkage (CHeReL) performed data linkage for the project using probabilistic record linkage methods and Choicemaker software.

3.4 Measurement

3.4.1 Systematic review and meta-analysis

For the systematic review and meta-analysis, studies in which depression, anxiety and self-harm were confirmed by validated self-report screening instruments, structured interviews or other diagnostic criteria were included.

As described below, both the ALSWH and NSW linked data projects used standardised and validated instruments.

3.4.2 Measurements used by the ALSWH

For the ALSWH data analyses, the dependent (outcome) variables were social support (Chapter 5), depressive symptoms, anxiety symptoms (Chapter 6 and 8) and HRQoL during pregnancy (Chapter 9), whereas social support was used as an independent (exposure) variable (Chapter 6 and 9) and mediator variable (Chapter 8 and 9).

Social support given to pregnant women was assessed using Medical Outcomes Study Social Support index (MOS-SSS-19 item). MOS-SSS has an overall index of 19 items and three functional support subscales:

- Emotional/informational support (involves caring, love and empathy) (8 items).
- Tangible support (material aid or behavioural assistance) (4 items).
- Affectionate support/positive social interaction (involving expressions of love and affection/the availability of other persons to do fun things) (7 items).

All subscales are reliable (Cronbach's Alphas greater than 0.91). For a binary variable, the overall social support and each domain of social support were categorised into high ("all of the time" and "most of the time") and low ("a little of the time/none" and "some of the time") social support based on average score (Sherbourne & Stewart, 1991). Also, the overall and individual domains of the MOS-SSS-19 item can be used as a continuous variable, with a higher score indicating greater social support (Sherbourne & Stewart, 1991). Social support was used as a binary outcome variable (Chapter 4), binary exposure variable (Chapter 5) and continuous exposure variable (Chapter 7 and 8).

Depression was assessed using the 10-item Center for Epidemiological Studies Depression (CES-D-10) scale. A cutoff point greater than or equal to ten from the total score indicates the presence of depressive symptoms (Andresen et al., 1994). The anxiety symptoms among pregnant mothers were assessed using the 9-item (yes/no) Anxiety subscale of the Goldberg Anxiety and Depression scale (GADS). A score of greater than or equal to six indicates the presence of anxiety symptoms and has a good reliability with Cronbach's alpha of 0.77 (Goldberg et al., 1988). Also, respondents were asked to specify whether they had been diagnosed or treated in the previous three years for depression (not postnatal), anxiety, and depression (postnatal) to examine their prior history of mental illness.

The Australian version of the Medical Outcomes Study 36-item Short Form Survey (SF-36) was employed to examine the quality of life (Mishra & Schofield, 1998). The SF-36 produces eight subscales of health status and quality of life, each measured on a scale from 0 to 100, with higher scores representing better health. The Mental Component Scale (MCS) and Physical Component Scale (PCS) of the SF-36 were used to examine pregnant women's mental and physical HRQoL, with higher scores indicating a better QoL. Scores were standardized using Australian norms to get a mean of 50 and a standard deviation of 10 (Ware et al., 1992).

Income stress was measured by asking how the respondents manage their income, with response options: "impossible," "difficult all of the time," "difficult some of the time," "not too bad," or "easy." These were collapsed into two categories: "impossible/difficult all or some of the time" and "not too bad/easy." The level of stress in the past 12 months was assessed using the Perceived stress Questionnaire (Bell & Lee, 2002).

The consumption of alcohol among study participants was assessed using the National Health and Medical Research Council (NHMRC) guidelines and categorised as: low-risk drinkers, non-drinkers; rarely drinks; risky/high-risk drinks (Site, 2008). Due to the small number of

responses, the consumption of alcohol was then re-categorised as being either a "low-risk-drinker" (non-drinker, low-risk drinker/rarely drinks) or a "high-risk drinker" (risky/high-risk drinker) of alcohol. Also, based on their response to a question asking their current status of cigarette smoking, participants were categorised as either a "non-smoker" or a "current smoker" of cigarettes. Study participants were asked if they had used any of the following illicit drugs in the past 12 months; Marijuana, Amphetamines, LSD; Hallucinogens, Tranquillizers; Cocaine, Ecstasy/designer drugs; Inhalants; Heroin; Barbiturates; and Steroids. Based on their responses, the women were classified as being either a "non-user" or a "user" of an illicit drug.

Pregnancy body mass index (BMI) classified according to the WHO's classification, underweight (< 18.5 kg/m^2), normal weight (BMI 18.5–24.99 kg/m^2), overweight (BMI of 25–29.9 kg/m^2) and obese (BMI $\geq$ 30 kg/m^2) (WHO, 1995).

3.4.3 Measurements used by the NSW linked-data project

The dependent (outcome) variables for the NSW data-linkage data project were depressive disorder, anxiety disorder and self-harm. The diagnoses of pregnant women with depressive disorder, anxiety disorder and self-harm were coded per the criteria of the 10th version International Classification of Diseases and Related Health Problems, Australian Modification (ICD-10-AM) (Innes et al., 1997).

The independent (exposure) variable was the marital status of admitted pregnant women. The available response options on the relationship status during admission were never married, married/de facto relationship, separated, divorced, or widowed. Then, those with a marital status of never married, separated, divorced, and widowed were categorised as "non-partnered", whilst the remaining response (married and de facto relationship) were grouped as "partnered".

3.5 Statistical analyses

3.5.1 Systematic review and meta-analysis

For the systematic review and meta-analysis, antenatal depression, anxiety, and self-harm were the dependent (outcome) variables, while social support was the independent (exposure) variable. A meta-analysis of odds ratios for the association between social support and outcome variables were calculated after log-transforming the estimates from eligible studies. Studies were pooled to calculate pooled odds ratios (POR) and 95% confidence interval (CI) using a random-effect model (Borenstein et al., 2010). Adjusted odds ratios (AORs) were used as the

preferred measure of association for meta-analysis, but studies that analysed social support as a continuous exposure variable were reported in the narrative synthesis. The narrative data synthesis was separately conducted for the association between social support and antenatal depression, antenatal anxiety, and antenatal self-harm. The Newcastle-Ottawa Scale tool was used for a quality appraisal (Stang, 2010). Heterogeneity was assessed using Q and the I^2 statistics (Borenstein et al., 2010). Possible publication bias was evaluated by inspection of the funnel plot and Egger's regression tests (Egger et al., 1997; Ioannidis, 2008). The results of the tests suggested the existence of possible publication bias ($p<0.05$ in Egger's test), and the final effect size (POR) was determined using Duval and Tweedie's Trim and Fill analysis (Aitkin, 1999). STATA IC version 16 was used to conduct the meta-analysis. For all statistical analyses, statistical significance was set at $p <0.05$.

3.5.2 Australian Longitudinal Study on Women's Health (ALSWH)

For the second (Chapter five) and third paper (Chapter six), basic characteristics of the exposure and outcome variables were addressed by using descriptive statistics such as frequencies, proportions, mean, and standard deviation. Also, chi-squared tests and independent sample t-tests were used to test for crude associations between the outcome and independent variables. Variables with bivariate $p \leq 0.25$ were entered into a multiple logistic regression model, and then a backward stepwise model building approach with extensive adjustment of confounders was used. The adjusted model in the second paper (Chapter five) was used to identify the determinants of low social support in each domain and examine the association between domains of social support and antenatal depressive and anxiety symptoms in the third paper (Chapter six). The association between the exposure and outcome variables was measured by adjusted odds ratios (AOR) with the corresponding 95% CI. A p-value of < 0.05 was set for statistical significance.

For the fifth paper (Chapter eight), the mediating effects of social support in the relationship between perceived stress and antenatal depressive symptoms and anxiety symptoms was examined using a parallel mediation model. A one-way ANOVA and independent-sample t-test were used to explore the group mean difference across the continuous variables. In addition, a correlational analysis was used to test the relationship between the independent variable, mediator and outcome variables. The mediation effect is significant ($p < 0.05$) if the 95% confidence interval (CI) for the result of the mediation effect did not contain zero. The mediational model was analysed using the PROCESS macro (version 3.0) for SPSS. The statistical software SPSS version 26 was used for the remaining analyses.

For the sixth paper (Chapter nine), after adjusting for potential confounders, a multivariate quantile regression (QR) model was used to examine the association between social support and HRQoL (i.e., MCS and PCS). The association between social support and HRQoL was assessed at the 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Regression coefficients for each quantile and the corresponding 95% confidence interval (CI) were computed. The association was considered statistically significant at a p-value < 0.05. In this paper, mediation analysis was also used to examine the mediating effect of social support in the relationship between perceived stress and HRQoL using PROCESS macro (version 3.0) for SPSS. The comparison of the PCS and MCS scores between different participant groups was conducted using a t-test and one-way ANOVA. Pearson correlation coefficient was determined to test the relationships between perceived stress, social support, and components of HRQoL (MCS and PCS).

3.5.3 NSW linked-data project

The fourth paper (Chapter seven) analysed data from the NSW linked-data project. Three steps were undertaken to analyse the data: (1) frequencies and percentages were calculated to show the magnitude of the outcome variables (depressive disorder, anxiety disorder and self-harm) among pregnant admitted were determined; (2) cross-tabulations of the distribution of the exposure variable (partnered or non-partnered) across the confounding and outcome variables were generated, using Pearson's chi-square test and t-test to demonstrate statistically significant associations; and (3) after adjusting for confounders, a binary logistic regression model was employed to determine the association between marital status and mental disorders (i.e. depressive disorder, anxiety disorder and self-harm). The results of the regression analyses in the final model were described using an adjusted odds ratio (AOR) with the respective 95% confidence intervals (CI). The final model was assessed using the Hosmer and Lemeshow goodness of fit test (Hosmer & Lemeshow, 2000).

The summary of data sources and method of statistical analyses for each paper is presented below (Table 3.1).

Table 3.1: Overview of data source and models employed to analyse the data for papers included in the thesis.

S.no	Included papers	Data source	Method of analysis
1	The relationship between social support and mental health problems during pregnancy: a systematic review and meta-analysis	Published studies	Random-effect meta-analysis and narrative analysis
2	Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study	ALSWH	Descriptive statistics and logistic regression model
3	The association between social support and antenatal depressive and anxiety symptoms among Australian women	ALSWH	Descriptive statistics and logistic regression model
4	An examination of the association between marital status and antenatal mental disorders using linked health administrative data	NSW linked data	Descriptive statistics and logistic regression model
5	The mediational role of social support in the relationship between stress and antenatal anxiety and depressive symptoms among Australian women: a mediational analysis	ALSWH	Descriptive statistics and a mediational model
6	The direct and mediating effect of social support in the relationship between perceived stress and quality of life during pregnancy among Australian Women	ALSWH	Descriptive statistics, mediational analysis and quantile regression model

3.6 Ethics Approvals

The ALSWH was approved by the Human Ethics Committee of the University of Newcastle (#H-076-0795) and the University of Queensland (#2004000224). Study participants provided written informed consent, and their participation was voluntary. All researchers using ALSWH data are required to sign a "Memorandum of Understanding" and "Confidentiality agreement" prior to obtaining the requested de-identified data. The confidentiality of study participants was assured by strictly monitoring information. Also, for all the research stated in the thesis, ethics approval was obtained from the Human Research Ethics Committee of the University of Technology Sydney (ID: ETH20-5306, approved on 14/10/2020).

The NSW data linkage project uses routinely collected data, and there were no interactions between the researchers, participants, or data subjects. The NSW Population and Health Services Research Ethics Committee and the Human Research Ethics Committee of the University of New South Wales, and the University of Technology Sydney study approved this study (reference number: 2011/06/328).

Chapter Summary

This chapter detailed the methodology used for the studies reported in this thesis. Our study used cross-sectional analyses of survey six of the 1973–78 ALSWH cohort, and those who reported being pregnant (n = 493) were included in the current analyses (Chapter 5, 6, 8 and 9). Also, we have analysed the linked PDC, and APDC datasets obtained from the NSW linked data project (n = 598,599 pregnant women linked with 865,349 admissions) (Chapter 7). The following sequence of result chapters also includes methodological details.

Chapter 4: The relationship between social support and mental health problems during pregnancy: a systematic review and meta-analysis

This first-ever global-level systematic review and meta-analysis examined the association between social support and antenatal mental health problems. The published review attached below started with the background information by addressing the burden and determinants of antenatal depression, anxiety and self-harm, followed by an explanation given on how social support and mental health problems are related. The meta-analysis and narrative analysis results show the association between social support and each outcome variable (depression, anxiety and self-harm). This systematic review also detailed the social support measures and their psychometric property. Then, the discussion, conclusion and limitations of this review were presented at the end of the paper.

The review found a significant association between low social support and antenatal depression, anxiety, and self-harm.

The results presented in this chapter have been published in the *Reproductive Health* Journal:

> Bedaso, A., Adams, J., Peng, W., & Sibbritt, D. (2021). The relationship between social support and mental health problems during pregnancy: a systematic review and meta-analysis. *Reproductive health*, *18*(1), 1-23. https://doi.org/10.1186/s12978-021-01209-5.

Abstract

Background: Pregnancy is a time of profound physical and emotional change as well as an increased risk of mental illness. While strengthening social support is a common recommendation to reduce such mental health risks, no systematic review or meta-analysis has yet examined the relationship between social support and mental problems during pregnancy.

Methods: The PRISMA checklist was used as a guide to systematically review relevant peer-reviewed literature reporting primary data analyses. PubMed, Psych Info, MIDIRS, SCOPUS, and CINAHL database searches were conducted to retrieve research articles published between the years 2000 to 2019. The Newcastle-Ottawa Scale tool was used for quality appraisal, and the meta-analysis was conducted using STATA. The Q and the I^2 statistics were used to evaluate heterogeneity. A random-effects model was used to pool estimates. Publication bias was assessed using a funnel plot and Egger's regression test and adjusted using trim and Fill analysis.

Result: From the identified 3,760 articles, 67 articles with 64,449 pregnant women were part of the current systematic review and meta-analysis. From the total of 67 articles, 22 and 45 articles were included in the narrative analysis and meta-analysis, respectively. From the total articles included in the narrative analysis, 20 articles reported a significant relationship between low social support and the risk of developing mental health problems (i.e. depression, anxiety, and self-harm) during pregnancy. After adjusting for publication bias, based on the results of the random-effect model, the pooled odds ratio (POR) of low social support was AOR: 1.18 (95% CI: 1.01, 1.41) for studies examining the relationship between low social support and antenatal depression and AOR: 1.97 (95% CI: 1.34, 2.92) for studies examining the relationship between low social support and antenatal anxiety.

Conclusion: Low social support shows significant associations with the risk of depression, anxiety, and self-harm during pregnancy. Policy-makers and those working on maternity care should consider the development of targeted social support programs with a view to helping reduce mental health problems amongst pregnant women.

Keywords: Social support, Pregnancy, Mental illness, Anxiety, Depression, Self-harm, Systematic review, Meta-analysis

Background

Pregnant women are at increased risk of developing mental health problems such as depression, anxiety, and self-harm (Davalos et al., 2012; Smith et al., 2011), a risk that can be exacerbated by different factors like financial and relationship issues and low social class (Brown et al., 2011; Diego et al., 2006; Divney et al., 2012). The common mental health problems women experience during pregnancy are anxiety (Dunkel Schetter, 2011), depression (Rich-Edwards et al., 2006) and self-harm (Say et al., 2014). Antenatal anxiety is defined as excessive worries, concerns, and fears about pregnancy, childbirth, the health of the infant, and future parenting roles (Huizink et al., 2004). Individual studies have reported that the prevalence of antenatal anxiety range between 14–59% (Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010a; Teixeira et al., 2009), while a meta-analysis conducted on estimating the global prevalence of antenatal anxiety found that pooled prevalence of antenatal anxiety symptoms across all trimesters was 34.4% in low to middle-income countries and 19.4% in high-income countries (Dennis et al., 2017).

Depression is the most prevalent mental health problem during pregnancy (Murray et al., 1996), characterized by symptoms such as depressed mood, low self-esteem, loss of interest, feelings of worthlessness, irritable mood, loss of appetite, feelings of fatigue and poor concentration (Kastrup & Ramos, 2007). An umbrella review conducted on examining the global prevalence of antenatal depression reported 15-65% and 17% prevalence of antenatal depression in low to middle-income countries and high-income countries, respectively, based on ten identified systematic reviews (Dadi, Miller, Bisetegn, et al., 2020).

Self-harm during pregnancy is one of the indirect causes of maternal death, especially among those who have already developed mental health problems. For example, in a study conducted in Bangladesh, among depressed pregnant women, nearly 14% were admitted due to thoughts of self-harm (Gausia et al., 2009), and in high-income countries, suicidal ideation is experienced by 3 to 33% of pregnant women (Frautschi et al., 1994; Newport et al., 2007). A global level review found that the prevalence of suicidal ideation during pregnancy and postpartum ranges from 5 to 14% (Lindahl et al., 2005).

Antenatal depression and anxiety negatively affect several obstetric and fetal outcomes and, if not effectively managed, can lead to pregnancy complications, postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995; Steer et al., 1992; Stott, 1973), and the risk of impaired interaction between mother and infant (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004; Murray et al., 1996). Mental illness during pregnancy is also associated with increased risk-taking behaviours such as smoking and the

use of other substances that can thereby result in a poor antenatal quality of life (Dunkel Schetter, 2011; Shapiro et al., 2013; Straub et al., 2014).

One common strategy to help prevent or reduce pregnancy complications and adverse birth outcomes as a consequence of mental illness is to provide strong social support for the pregnant mother (Dunkel Schetter, 2011; Norbeck et al., 1996; Orr & Miller, 1997). Social support is characterized by the degree to which social relationships fill specific needs (e.g. emotional, instrumental, affectionate, and/or tangible social support) or the degree of social integration (Berkman, 2000; Sherbourne & Stewart, 1991). Social support is assumed to improve individuals' positive interactions that can help reduce depression, stress, and anxiety and therefore reduce the risk of adverse pregnancy and birth outcomes (Cohen & Wills, 1985). Social support can also provide an additional suitable coping mechanism for pregnant women to handle stressful events (Cohen & Wills, 1985; Dunkel Schetter, 2011).

Different epidemiological studies have revealed that low social support is significantly associated with depression (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018), anxiety (Biaggi et al., 2016; Nasreen et al., 2011) and self-harm (e Couto et al., 2016) during pregnancy. However, no systematic review and/or meta-analysis has been conducted to collate and critically review findings from individual studies, making the available evidence more accessible to decision-makers and providing an estimate of the magnitude of the associations between social support and mental health problems like depression, anxiety, and/or self-harm among pregnant women. In direct response to this significant research gap, this systematic review and meta-analysis aimed at examining whether low social support is associated with an increased risk of mental health problems during pregnancy. We hypothesized that low social support is significantly associated with depression, anxiety and/or self-harm during pregnancy.

Methods

Information source, search strategy and study selection process

This systematic review and meta-analysis was conducted, and results were reported following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist (Page et al., 2021) (Additional file 4.1). This systematic review and meta-analysis protocol has been registered in PROSPERO (CRD42020155981). All peer-reviewed published articles were systematically searched through a number of electronic databases, including PubMed, Maternal and Infant care database (MIDIRS), PsychINFO, SCOPUS, and CINAHL.

We used the following search terms and key words used for searching from the PubMed database: ((((((((("Depression" [Mesh] OR "Depressive Disorder" [Mesh] OR "Depressive

Disorder, Major" [Mesh])) OR depression [Title/Abstract]) OR depressive symptom [Title/Abstract])) OR ((Anxiety disorder [Title/Abstract]) OR ((anxiety [Title/Abstract]) OR ("Anxiety" [Mesh] OR "Anxiety Disorders" [Mesh]))))) OR (((((((("Self-Injurious Behavior" [Mesh]) OR self-harm [Title/Abstract]) OR ("Self-Mutilation" [Mesh])) OR suicide [Title/Abstract]) OR "Suicide" [Mesh])) OR "Mental Health" [Mesh])) AND ((((("Social Support" [Mesh] OR "Psychosocial Support Systems" [Mesh])) OR social support [Title/Abstract]) OR Psychosocial support [Title/Abstract]) OR emotional support [Title/Abstract]) OR instrumental support [Title/Abstract])) AND (((("Pregnancy" [Mesh]) OR "Pregnant Women" [Mesh])) OR pregnancy [Title/Abstract]) OR pregnant women [Title/Abstract]). For the other four electronic databases (CINAHL, MIDIRS, Psych INFO, and SCOPUS), specific database subject headings linked with the above terms and keywords were used. Search limits used in the databases include English literature and the period starting from January 1, 2000 to November 8, 2019. Also, we have manually searched the reference lists of included studies to identify additional articles. Using Covidence software (Kellermeyer et al., 2018), the identified publications were evaluated by their titles, abstract, duplication and full-text contents against the pre-specified inclusion and exclusion criteria.

We employed the PICO model to determine the eligibility for the study: Population: (1) Adults pregnant women aged ≥18 years*;* (2) Intervention(s)/exposure(s) group: Pregnant women who receive low social support*;* (3) Comparison group(s): Pregnant women who receive high/good social support*;* (4) Outcomes: Depression/Depressive symptoms, Anxiety disorder/Anxiety symptoms and self-harm among pregnant women. The initial search and selection of studies were undertaken by AB. Full-text articles were later checked for their eligibility by two investigators (AB and WP). Disagreements were resolved through discussion with a third and fourth investigator (JA, DS) for the final selection of studies.

Eligibility Criteria

Studies that fulfil the following criteria were included. Firstly, studies that assessed and reported empirical data (primary or secondary) on the association between social support and depression, anxiety, or self-harm during pregnancy. Second, the types of study design are limited to observational studies such as cross-sectional, case-control, or cohort study design. Third, the participants of reported studies needed to be adult pregnant mothers whose age is 18 years old and above. Fourth, studies in which depression, anxiety and self-harm were confirmed by validated self-report screening instruments, structured interviews or other diagnostic criteria. The exclusion criteria were as follows: (1) Studies like clinical trials, literature reviews, commentaries, short communications, and letters to the editor, (2) studies

that failed to report tools used to confirm the presence of mental health problems (depression, anxiety and self-harm) and the tool used to measure the social support given for pregnant women and (3) studies not published in the English language.

Definition of outcome variables

In this study, mental health problems were operationalized as any diagnosed depressive disorders, general anxiety disorder, or suicidality (thoughts of self-harm or suicidal attempt) according to standard diagnostic criteria such as the International Classification of Disease (Cowan, 2001), the Diagnostic Statistical Manual of Mental Disorders (DSM) (APA, 2012) or identified depressive symptoms or anxiety symptoms based on the valid screening tool.

Definition of the exposure variable

In the current study, social support is broadly defined as the provision of emotional (e.g. caring), or informational (e.g. notifying someone of important information) support, instrumental (e.g. helping with housekeeping), tangible (e.g. practical support like financial aid), and/or psychological support for somebody by the social network of family members, friends, or community members (Cohen et al., 2004).

Quality appraisal and methods of data extraction

The modified version of the Newcastle-Ottawa Scale (NOS) was used to evaluate the methodologic quality (sample size, representativeness, comparability, non-response, ascertainment of outcome and statistical analysis) of the studies included in the current systematic review and meta-analysis (Stang, 2010). Data extraction was independently completed from articles with good quality standards (NOS score $\geq$7 points) by two investigators (AB, WP) (Moher et al., 2015). During the review process, any disagreement between the two investigators (AB, WP) was resolved through continuous discussion with review team members until a consensus was reached. A specific form of data extraction format prepared in the Microsoft Excel spreadsheet (Additional file 4.2) was used. The following information was extracted from eligible full-text articles: author's name, year of publication, country, sample size, study design, type of support, source of support, instrument employed, study setting, and measure of association and confidence interval.

Data synthesis method

STATA IC version 16 statistical software was used to conduct a meta-analysis and estimate effect sizes. Studies were pooled to calculate pooled adjusted odds ratios and 95% CI using a random-effect model (Borenstein et al., 2010). Adjusted odds ratios (AORs) were used as the

preferred measure of association for meta-analysis; however, studies that analyse and report social support as a continuous exposure variable were reported in the narrative analysis. The narrative analysis was separately conducted for the association between social support and antenatal depression, antenatal anxiety, and antenatal self-harm. Among the studies included in the meta-analysis, most studies compared low social support with high/good social support. However, studies using low social support as a reference category were changed using the reciprocal method to maintain uniformity (Higgins et al., 2003). A meta-analysis of adjusted odds ratios for the association between low social support and outcome variables were calculated after log-transforming the estimates from eligible studies. If more than one outcome was reported from a single study, each outcome was analysed independently.

Publication bias, heterogeneity, and subgroup analysis

Possible publication bias was assessed through inspection of the funnel plot and Egger's regression tests (Egger et al., 1997; Ioannidis, 2008). The results of the tests suggested the existence of possible publication bias ($p<0.05$ in Egger's test), and the final effect size (POR) was determined using Duval and Tweedie's Trim and Fill analysis in the Random-effects model (Aitkin, 1999). The trim and fill analysis is a non-parametric method for approximating the number of missing studies that might exist and helps in reducing and correcting publication bias in meta-analysis. The presence of heterogeneity between studies was assessed using Q and the I^2 statistics (Borenstein et al., 2010). The I^2 provides an estimate of the percentage of the variability in effect estimates due to heterogeneity rather than sampling error or chance differences. I^2 statistics range from 0 to 100%, and values of 25, 50 and 75% were considered to represent low, medium and high, respectively (Higgins & Thompson, 2002). A value of 0% indicates no observed heterogeneity, while 100% indicates significant heterogeneity and a p-value <0.05 was used to declare significant heterogeneity (Higgins & Thompson, 2002). The possible sources of heterogeneity were identified using a univariate meta-regression model. Sub-group analyses were conducted based on study design, study setting, economic level of countries (low, middle and high income), median sample size and publication year. Sensitivity analysis was also undertaken to examine the effect of a single study on the overall effect size.

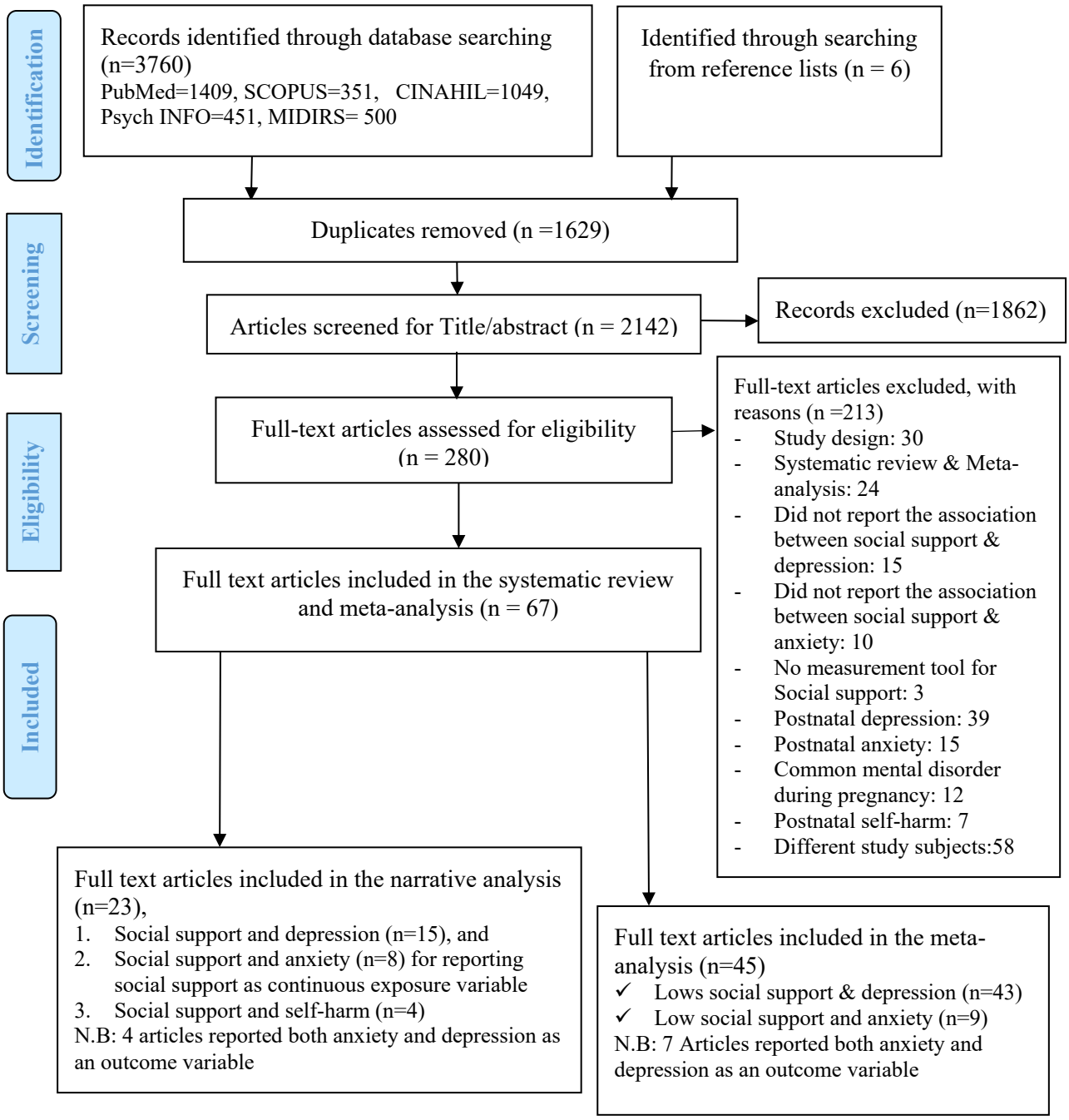
Result

Selection of studies

As indicated in Figure 4.1, 3,760 papers were retrieved from five electronic databases during the search strategy. Also, an additional six citations were identified through a manual search of reference lists. After 1,624 duplicates were removed, preliminary screening of the titles and

abstracts of 2,142 articles was conducted, and as a result, a further 1,862 articles were excluded. The remaining 280 articles met the criteria for full-text review, with another 213 articles being excluded. Finally, 67 articles fulfilled the inclusion criteria and were included in the current systematic review and meta-analysis.

PRISMA 2020 Flow Diagram



* One article (Nasreen et al., 2011) was included both in the narrative and meta-analysis.

Figure 4.1: PRISMA flow chart of the study identification process for systematic review and meta-analysis, 2020.

Study characteristics

The characteristics of the included articles are presented in Table 4.1. Of the studies included in the present systematic review and meta-analysis, 21, 18, and 16 studies were conducted in high, middle, and low-income countries, respectively representing 64,449 pregnant women. The majority of the studies, 31(47%), used the Edinburgh Postnatal Depression Scale (EPDS) for screening antenatal depression. The sample size of included studies ranges between 82 participants in the US (Zauszniewski, 2019) and 5337 participants in Canada (Fall et al., 2013).

Table 4.1: Summary characteristics of studies investigating the association between social support and mental health problems (depression, anxiety and self-harm) during pregnancy (N=66, from 2000.2019).

S. no	Author, country, publication year	Type of support	Source of support	Sample size	Setting	Study design	Measurement		Measure of association
							Mental health problems	Social support	
1	(Abujilban et al., 2014), Jordan	General support	Family/Non-family	218	Facility	Cross-sectional	Depression: EPDS	DUSOCS (12 items)	r= -0.022, P>0.05
2	(Adewuya et al., 2007), Nigeria	Emotional/Instrumental support	Partner	181	Facility	Cross-sectional	Depression: EPDS	PSSS	AOR: 6.08 (1.42, 26.04)
3	(Agostini et al., 2015), Italy	General support	Partner/Family/Friend	404	Facility	Longitudinal	Depression: EPDS	MSPSS	AOR: 1.06 (1.03, 1.08)
4	(Akiki et al., 2016), UK	General support	Family	1992	Facility	Longitudinal	Anxiety: STAI	PSS	β= -0.044, P=0.029
			Partner						β=-0.033, P=0.0051
5	(Anindyajati et al., 2017), Indonesia	General support	Partner/Family	107	Community	Cross-sectional	Depression: LPGD	KD-24 item	AOR 0.21(0.05, 0.84)
6	(Bayrampour et al., 2015), Canada	General support	Family/Partner	3021	Facility	Longitudinal	Depression: EPDS	MOS-SSS (19 item)	AOR 3.09 (1.65, 5.78)
							Anxiety: STAI		AOR 3.37 (2.14, 5.33)
7	(Belay et al., 2018), Ethiopia	General support	Partner	363	Facility	Cross-sectional	Depression: BDI	MSSS	AOR 4.76 (1.51, 14.28)
8	(Bernard et al., 2018), Jamaica	Emotional support	Partner	3571	Facility	Longitudinal	Depression: EPDS	MSPSS	AOR 3.14 (1.69, 5.84)
9	(Biratu & Haile, 2015), Ethiopia	General support	Partner	422	Facility	Cross-sectional	Depression: EPDS	PSS	AOR 1.89 (1.06, 3.35)
10	(Bisetegn et al., 2016), Ethiopia	General support	Family/Partner	527	Community	Cross-sectional	Depression: EPDS	OSSS-3	AOR 1.57 (0.79,3.11)
11	(Cankorur et al., 2015), Turkey	Emotional/Practical support	Family/Partner	730	Facility	Longitudinal	Depression: EPDS	CPQ	AOR 1.07, (1.01, 1.15)
12	(Chee et al., 2005), Singapore	General support	Family/Partner	724	Facility	Longitudinal	Depression: EPDS	MOS-SSS (19 items)	AOR 2.53 (1.07–6.02)
13	(Cheng et al., 2016), USA	General support	Friend/Partner/Relatives	1764	Facility	Longitudinal	Depression: EPDS	PSS	AOR: 3.1 (1.7, 5.7) (Project viva)

				877			Anxiety: STAI		AOR: 1.9 (1.1, 3.3) (Project access)
14	(Clements et al., 2016), USA	General support	Family/Partner	106	Facility	Longitudinal	Depression: CESD	PPP	β=-0.44, P<0.001 (1st trimester)
									β=-0.33, P<0.001 (2nd trimester)
15	(Dibaba et al., 2013), Ethiopia	General support	Family/Partner	627	Community	Cross-sectional	Depression: EPDS	MSSS	AOR 4.34 (2.12, 9.1)
16	(Dong et al., 2013), China	General support	Partner	520	Facility	Cross-sectional	Depression: EPDS	OSSS-3	AOR: 1.75 (0.16–19.28),
			Parents						AOR: 0.56 (0.06–5.13),
			Parents-in-law						AOR: 0.74 (0.24–2.23)
17	(Dudas et al., 2012), Hungary	General support	Partner	1719	Community	Cross-sectional	Depression: LQ	MSPSS	AOR: 1.79(1.32–1.89)
18	(Duko et al., 2019), Ethiopia	General support	Partner/Parents/Parents-in-law	317	Facility	Cross-sectional	Depression: EPDS	OSSS-3	AOR: 2.14 (1.49, 3.11)
19	(Dunkel Schetter et al., 2016), Canada	General support	Family/Partner	5271	Facility	Longitudinal	Anxiety: BIPS	MOS-SSS (19 items)	β= 0.08 (0.01, 0.15), P>0.05
20	(Fall et al., 2013), Canada	General support	Family	5337	Facility	Longitudinal	Depression: CES-D	ASSI	AOR: 4.47 (3.55-5.63)
21	(Gao et al., 2019), China	Emotional/Instrumental support	Partner	278	Facility	Cross-sectional	Anxiety: SAS	PSSS	AOR: 2.86 (1.70, 4.83),
							Depression: EPDS		AOR: 2.56 (1.52, 4.30)
22	(Golbasi et al., 2010), Turkey	Emotional/Instrumental support	Family/Partner/Friend	258	Facility	Cross-sectional	Depression: EPDS	MSPSS	r= -0.43; P<0.001.
23	(Gourounti et al., 2013), Greece	General support	Family/Friends/ Partner	165	Facility	Cross-sectional	Anxiety: STAI	SSQ-6	β= 0.131 (0.19, 2.37)
24	(Hain et al., 2016), Germany	Emotional/Instrumental support	Family/Partner/Non-family	297	Facility	Longitudinal	Depression: EPDS	F-SozU K-14	r= -0.45, p<0.01
25	(Herbell & Zauszniewski, 2019), USA	General support	Family/Partner	82	Facility	Cross-sectional	Depression: CESD	MOS-SSS (19 items)	β= -0.751, P<0.001

26	(Heyningen et al., 2016), South Africa	Emotional/Instrumental support	Friends	376	Facility	Cross-sectional	Anxiety: MINI	MSPSS	AOR: 1.05 (1.01, 1.09)
27	(Jeong et al., 2013), South Africa	Emotional support	Mother	1262	Facility	Cross-sectional	Depression: EPDS	MSPSS	AOR: 1.5 (1.31–1.71)
28	(Lau, 2011), China	Emotional/Tangible support	Family	1609	Facility	Cross-sectional	Depression: EPDS	ISEL	AOR: 1.9 (1.582, 2.520)
29	(Lee et al., 2007), Hong Kong	Emotional/Instrumental support	Partner	357	Facility	Longitudinal	Anxiety: HADS	PSSS	AOR: 1.72 (1.05, 2.85)
							Depression: HADS		AOR: 1.69 (1.01, 2.85)
30	(Li et al., 2017), China	Emotional/Instrumental support	Partner	240	Facility	Longitudinal	Depression: EPDS	PSSS	AOR 0.99 (0.94, 1.05)
31	(Nath et al., 2019), India	Emotional/Instrumental support	Family/Partner	380	Facility	Cross-sectional	Anxiety: PRT	MSPSS	AOR: 1.76 (1.04, 2.98)
32	(Onah et al., 2017), South Africa	Emotional/Instrumental support	Family/Friends/Partner	376	Facility	Cross-sectional	Self-Harm: SIB	MSPSS	AOR: 1.07 (1.01, 1.15)
33	(Pajulo et al., 2001), Finland	General support	Partner/Parents/Mother-in-law/Friend	391	Facility	Cross-sectional	Depression: EPDS	SSQ-12	AOR: 4.2 (0.9, 20.2)
34	(Rashid & Mohd, 2017), Malaysia	General support	Partner/Parents/Parents-in-law	3000	Facility	Cross-sectional	Depression: EPDS	OSSS-3	AOR: 2.16 (1.77, 2.64)
35	(Rubertsson et al., 2003), Sweden	General support	Partner/Parents/Parents-in-law	608	Facility	Longitudinal	Depression: EPDS	OSSS-3	AOR: 6.9 (3.4, 13.9)
36	(Shafaie et al., 2018), Iran	General support	Family/Partner	372	Facility	Cross-sectional	Anxiety: DASS	PRQ- 85	r= -0.456, p<.001
							Depression: DASS		r= -0.642, p<.001
37	(Sheeba et al., 2019), India	Emotional/Instrumental support	Family/Friends/Partner	280	Facility	Longitudinal	Depression: EPDS	MSPSS	AOR: 1.785(0.915, 3.48)
38	(Sidebottom et al., 2017), USA	General support	Family/Friend	2341	Facility	Longitudinal	Depression: PHQ-9	MSSI	AOR: 1.85 (1.31, 2.60)
39	(Spoozak et al., 2009), USA	Emotional/Instrumental support	Mother/ Partner	783	Facility	Cross-sectional	Depression: CIDI	MKSSI	AOR: 2.39 (1.63, 3.52)
40	(Stewart et al., 2014), Malawi	Emotional/Instrumental support	Family/Partner/Friend	503	Facility	Cross-sectional	Depression: DSM IV	MSPSS	AOR 1.11 (1.04, 1.17)

41	(Tang et al., 2019), China	General support	Family/Partner	1220	Facility	Longitudinal	Anxiety: HAMA	SSRS-10	AOR: 5.09 (2.41, 10.77)
							Depression: SDS		AOR 3.18 (1.46, 6.96)
42	(Verreault et al., 2014), Canada	General support	Family/Partner /Friends	364	Facility	Cross-sectional	Depression: EPDS	MOS-SSS (19 items)	β: -0.32, P< 0.001
43	(Woldetensay et al., 2018), Ethiopia	General support	Family/Friends/Partner	4680	Community	Longitudinal	Depression: PHQ-9	MSSS	AOR: 1.63 (1.31–2.02)
44	(Yanikkerem et al., 2013), Turkey	Emotional/Instrumental support	Partner	651	Facility	Cross-sectional	Depression: BDI	PSSS	β= 2.42, (0.707, 4.135)
45	(Zeng et al., 2015), China	Emotional/instrumental support	Family/Partner /Friend	292	Facility	Cross-sectional	Depression: SDS	SSRS-10	AOR 1.08 (1.03, 1.13)
46	(Sahile et al., 2017), Ethiopia	General support	Partner/Parents/Parents-in-law	231	Facility	Cross-sectional	Depression: BDI	OSSS-3	AOR: 2.63 (0.34, 20
47	(Records & Rice, 2007), USA	Emotional/Instrumental support	Family/Friends/Partner	139	Facility	Cross-sectional	Depression: CESD	MSPSS	β=1.64, P<0.001
48	(Marchesi et al., 2014), Italy	General support	Family/Friends/Partner	277	Facility	Longitudinal	Anxiety: HADS	ASSI	AOR: 4.2 (1.1, 15.5)
49	(Waqas et al., 2015), Pakistan	General support	Family/Friend/ Partner/Others	500	Facility	Cross-sectional	Anxiety-HADS	SPS	r = −0.433, P < 0.001
							Depression-HADS		r= −0.453, P < 0.001
50	(Westdahl et al., 2007), USA	General support	Family/Parent	1047	Facility	Longitudinal	Depression: CESD	SSRS-10	AOR: 2.29 (1.21, 4.33)
51	(Nasreen et al., 2011), Bangladesh	General support	Partner/Parents/Parents-in-law	720	Community	Longitudinal	Depression: EPDS	OSSS-3	AOR: 2.23 (2.12, 3.62).
							Anxiety: STAI		β: -1.1447, P < 0.05
52	(Leigh & Milgrom, 2008), Australia	General support	Family/Friend/ Partner/Others	367	Facility	Longitudinal	Depression: BDI	SPS	β= -0.18, P<0.001
53	(Martini et al., 2015), Germany	General support	Family/Friends/Partner	306	Community	Longitudinal	Anxiety: CIDI-V	SSQ-12	AOR: 2.27 (1.42, 3.70)
							Depression: CIDI V		AOR: 2.43, (1.19, 5)
54	(Rubertsson et al., 2003), Sweden	General support	Partner/Parent/ Parents-in-law	3011	Facility	Longitudinal	Depression: EPDS	OSSS-3	AOR: 4.4 (2.7, 7.4)
55		General support		158	Facility	Longitudinal	Anxiety: STAI	MSSS	β= −0.79(−1.16,−0.42)

	(Huang et al., 2019), Taiwan		Family/Friends/Partner				Depression: EPDS		β= −0.44 (-0.63, -0.24)
56	(Jesse et al., 2005), USA	General support	Partner/Others	130	Facility	Cross-sectional	Depression: BDI	PPP	AOR:1(0.98,1.02),P>0.05
57	(Blaney et al., 2004), USA	General support	Friend/Partner/Relatives	325	Facility	Cross-sectional	Depression: CESD	PSS	r= -0.25, P<0.001
58	(Glazier et al., 2009), Canada	Emotional/Instrumental support	Family/Friends/Partner	2,052	Facility	Longitudinal	Depression: CESD,	MSPSS	r= -7.38, P< 0.01
						Longitudinal	Anxiety: STAI		r= -7.34, P <0.01
59	(Senturk et al., 2011)	General support	Partner	772	Facility	Cross-sectional	Depression: EPDS	CPQ	β= -2.6 (-3.6, -1.7)
		Emotional support	Mother in-low						β=-2.6,95%CI (-4.6,-1.9)
		Practical support							β=-0.8,95%CI (-1.4,-0.3)
60	(Gausia et al., 2009), Bangladesh	General support	Mother in-low	361	Community	Cross-sectional	Depression: EPDS	PPP	AOR:2.41(1.31, 4.45)
			Partner						AOR: 8.26 (1.66, 41)
61	(Shidhaye et al., 2017), India	General support	Friend/Partner/Relatives	302	Facility	Cross-sectional	Depression: EPDS	PSS	AOR: 3.33 (1.42, 5)
62	(Hartley et al., 2011), South Africa	Emotional/Practical support	Family/Partner	1062	Facility	Longitudinal	Depression: EPDS	CPQ	AOR: 1.13 (1.03, 1.25)
63	(Rwakarema et al., 2015), Tanzania	General support	Family/Friends/Partner	397	Facility	Cross-sectional	Depression: EPDS	MSSS	AOR: 1.41 (0.60, 3.28)
64	(Heyningen et al., 2016), South Africa	Emotional/Instrumental support	Family/Friends/Partner	376	Facility	Cross-sectional	Depression: EPDS	MSPSS	AOR: 1.14 (1.06, 1.22)
65	(e Couto et al., 2016), Brazil	General support	Partner/Parents/Parents-in-law	255	Facility	Cross-sectional	Self-harm: MINI	OSSS-3	AOR: 1.75 (0.62, 5),
66	(Pinheiro et al., 2012), Brazil	Emotional/Instrumental support	Family/Friends/Partner	871	Facility	Cross-sectional	Self-harm: MINI	MOS-SSS (7 items)	AOR: 3.03 (1.78, 5.26)
67	(Supraja et al., 2016), India	General support	Spouse, other family members, & friends	462	Facility	Cross-sectional	Self-harm: SBQ-R	MSSS-8 item	AOR: 1.17 (1.02, 2.35)

The articles included in the current systematic review and meta-analysis used 22 different valid measures of social support tools. From the total social support measures, the 3-item Oslo social support scale (OSSS-3) and the Multidimensional Scale of Perceived Social Support (MSPSS) were the most dominant ones used by 11 and 10 studies, respectively (Figure 4.2).

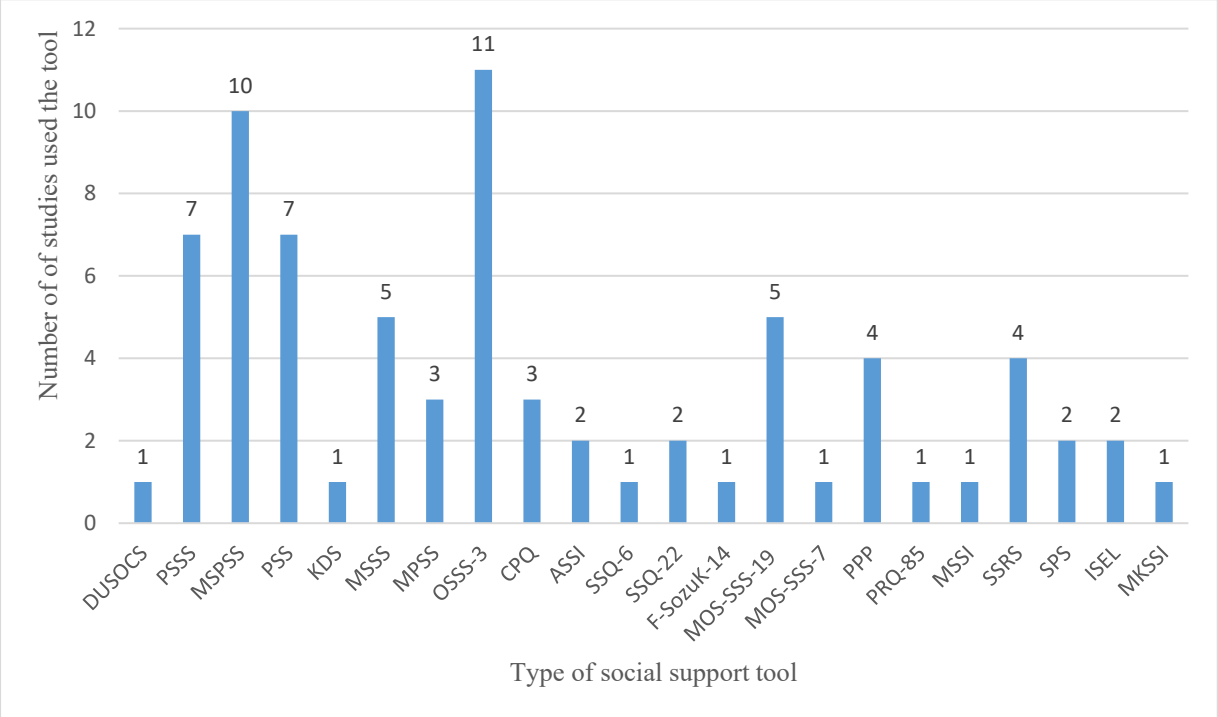


Figure 4.2: Types of social support tools used by the studies included in the current study.

Details on the social support tools used and their reliability is outlined in Table 4.2. Overall, from the total identified articles, 45 studies reported odds ratio (OR) as a measure of association between social support with antenatal depression, and we included them in the meta-analysis presented here. Nine studies reported odds ratio (OR) as the measure of association between social support and antenatal anxiety and were included in the meta-analysis presented here. Twenty-three studies were included in the narrative analysis for analysing social support as a continuous variable (Abujilban et al., 2014; Akiki et al., 2016; Blaney et al., 2004; Clements et al., 2016; Dunkel Schetter et al., 2016; Glazier et al., 2009; Golbasi et al., 2010; Gourounti et al., 2013; Hain et al., 2016; Herbell & Zauszniewski, 2019; Huang et al., 2019; Leigh & Milgrom, 2008; Nasreen et al., 2011; Senturk et al., 2011; Shafaie et al., 2018; Verreault et al., 2014; Waqas et al., 2015; Yanikkerem et al., 2013). Also, four studies (e Couto et al., 2016; Onah et al., 2017; Pinheiro et al., 2012; Supraja et al., 2016) that examined the relationship between self-harm and social support were included in the narrative analysis.

Table 4.2: Social support tools used, concepts measured and their reliability.

S.no	Type of Social support tool used	Concepts measured	Cronbach Alpha
1	The Duke Social Support and Stress Scale (DUSOCS) (12 items) (Salameh, 2006)	Family & non-family relationships in terms of the amount of social support they provide and the number of supportive people	0.74
2	Multidimensional Scale of Perceived Social Support (MSPSS) (12 items) (Hatton et al., 2007)	The subjective adequacy of emotional and instrumental social support from three different sources (family, friends, and partner)	0.83
3	Kuesioner Dukungan Sosial (KDS) (24 item) (Ismail, 2001)	Support from the husband, extended families from both sides, environmental support, the mother's preparedness, and traditional rituals	0.788
4	Medical Outcomes Study Social Support Survey (MOS-SSS) (7 items) (Sherbourne & Stewart, 1991)	Perceived emotional and instrumental support from one's social network	0.88
5	Medical Outcomes Study Social Support Survey (MOS-SSS) (19 items) (Sherbourne & Stewart, 1991)	Perceived emotional/informational support, tangible support, affectionate support, and positive social interaction	0.97
6	Oslo Social Support Scale(OSSS-3 item) (Dalgard et al., 2006)	Support received from husband, parents, and parents-in-law.	0.88
7	Close Person Questionnaire (CPQ) (Stansfeld & Marmot, 1992)	Emotional support, practical support, and negative aspects of the relationship	0.85
8	Partner social support Scale (PSSS) (Turner et al., 1990)	Support received from a partner (Emotional, instrumental and dependent on the partner)	0.89
9	Antenatal Psychosocial Profile (PPP) (Curry et al., 1994)	Social support from partners and others	0.71
10	Arizona Social Support Interview (ASSI) (Barrera Jr, 1981)	Availability of support from social network/family: instrumental, emotional, informative, normative, and companionship	0.7
11	Maternal Social Support Index (MSSI) (18 items) (Pascoe et al., 1988)	Support received from family, friends, and her feeling about the support. Also, the support received on routine home duties (watching children and doing other activities).	0.81
12	Modified Kendler Social Support Interview (MKSSI) (27 items) (Kendler et al., 2005)	Emotional and instrumental support	0.68
13	Social Support rating scale (SSRS) (10 items) (Xiao, 1994)	Objective support, subjective support, and support-seeking behavior	0.76

14	Social provision Scale (SPS) (24 items) (Rizwan & Syed, 2010)	Intimacy, social integration, a reassurance of worth, and support from friends, family members, coworkers, community members, and so on.	0.81
15	Social Support Questionnaire (12 items) (Fydrich et al., 2007)	Emotional support, instrumental support, social integration and measure perceptions of social support and satisfaction with that social support.	0.81
16	Social Support Questionnaire-6 (SSQ-6 item) (Kafetsios, 2002)	Availability of social support/number of supporters (SSQ-Network) and satisfaction with social support (SSQ-Satisfaction).	0.83
17	F-SozU K-14 (Fragebogen zur Sozialen Unterst€utzung; Social Support Questionnaire) (14 items) (Fydrich et al., 1999)	The perceived or anticipated emotional and instrumental support from one's social environment.	0.94
18	Interpersonal Support Evaluation List (ISEL) (40 items) (Cohen et al., 1985)	Perceived availability of aspects of social support like emotional, belonging, tangible, and self-esteem.	0.74
19	Personal resource questionnaire (PRQ-85) (85 items) (Weinert & Brandt, 1987)	Assessment of the number of resources a person can count across life situations and a person's satisfaction with these resources.	0.84
20	Perceived Social Support (PSS) (25 items) (Turner & Marino, 1994)	Social support from partner, friends, relatives, and co-workers	0.75
21	Social relationship Scale (SRS) (O'Brien et al., 1993)	Perceived availability of emotional and material support	0.87
22	Maternal Social Support Scale (MSSS) (6 items) (Webster et al., 2000)	Level of perceived support from family, friends, and husband.	0.74

Quality appraisal

From the included 67 articles, all scored greater or equal to 7 out of 10 on the NOS, which are thereby considered as being good quality, which provides insights into the robustness of our meta-analysis (Additional file 4.3).

Narrative analysis

Association between social support and antenatal depression

Fifteen studies that investigated the association (Clements et al., 2016; Herbell & Zauszniewski, 2019; Huang et al., 2019; Records & Rice, 2007; Verreault et al., 2014; Yanikkerem et al., 2013) or correlation (Abujilban et al., 2014; Blaney et al., 2004; Golbasi et al., 2010; Hain et al., 2016; Shafaie et al., 2018; Waqas et al., 2015) between social support and antenatal depression were included in the narrative analysis. Among these 15 studies, six reported a significant negative correlation between social support and antenatal depression (Abujilban et al., 2014; Blaney et al., 2004; Golbasi et al., 2010; Hain et al., 2016; Shafaie et al., 2018; Waqas et al., 2015). Also, a significant inverse relationship between social support and antenatal depression was reported by eight studies (Clements et al., 2016; Herbell & Zauszniewski, 2019; Huang et al., 2019; Leigh & Milgrom, 2008; Records & Rice, 2007; Senturk et al., 2011; Verreault et al., 2014; Yanikkerem et al., 2013), and one study (conducted in Jordan) (Abujilban et al., 2014) reported no evidence of a significant correlation between social support and antenatal depression.

Among four studies conducted in the US, an inverse relationship between social support and antenatal depression was reported from a facility-based longitudinal survey conducted on 106 pregnant mothers during the first trimester (β= -0.44, P<0.001) and second trimester (β=-0.33, P<0.001) (Clements et al., 2016). Similarly, another facility-based cross-sectional study reported negative (β: -0.751, P<0.001) (Herbell & Zauszniewski, 2019) and positive association (β=1.64, P<0.001) between social support and antenatal depression (Records & Rice, 2007). The fourth study, which recruited pregnant women through a stratified random sampling technique, revealed a negative correlation (n=325, r=-0.25, P<0.001) between social support and antenatal depression (Blaney et al., 2004).

Also, among three studies conducted in Turkey, a moderate negative correlation between the EPDS score and perceived social support was reported from a facility-based cross-sectional

study (n=258, r=-0.43; P<0.001) (Golbasi et al., 2010). Another facility-based cross-sectional study reported that social support was significantly related to depression (n=655, β=2.421, 95% CI (0.707, 4.135) (Yanikkerem et al., 2013). In addition, another facility-based study indicated that support from husband (n=772, β= -2.6 (-3.6, -1.7), emotional support (β=-2.6, 95% CI (-4.6, -1.9), and practical support (β= -0.8, 95% CI (-1.4, -0.3)) from mother in law have an inverse relation with antenatal depression (Senturk et al., 2011).

Negative correlation between social support and antenatal depression was reported from longitudinal studies conducted in Germany (n=297, r=-0.45, p<0.01) (Hain et al., 2016) and Canada (n=2052, r= -7.38, P<0.01) (Glazier et al., 2009). Similarly, a negative correlation was reported from facility-based cross-sectional studies conducted in Iran (r=-0.642, p<.001) (Shafaie et al., 2018) and Pakistan (r= −0.453, P<0.001) (Waqas et al., 2015). A cross-sectional study conducted in Canada reported that social support was negatively associated with antenatal depression (n=364, β: -0.32, P<0.001) (Verreault et al., 2014).

A study conducted in Australia on consecutively selected pregnant mothers emphasized that good social support was negatively associated with depression during pregnancy (n=367, β=-0.18, P<0.001) (Leigh & Milgrom, 2008). Similarly, a study from Taiwan reported an inverse relationship between social support and antenatal depression (n=158, β= −0.44, 95% CI (−0.63, −0.24), P<0.05) (Huang et al., 2019). Despite the above evidence of association, a cross-sectional study conducted in Jordan concluded that social support during pregnancy has no correlation with antenatal depression (r=-0.022, P>0.05) (Abujilban et al., 2014).

Association between social support and antenatal anxiety

Eight studies examined the association between social support and anxiety during pregnancy. Of these, seven studies reported significant association (Gourounti et al., 2013; Huang et al., 2019; Nasreen et al., 2011) or correlation (Akiki et al., 2016; Glazier et al., 2009; Shafaie et al., 2018; Waqas et al., 2015) between social support and antenatal anxiety. However, one study conducted in Canada (Dunkel Schetter et al., 2016) reported no evidence of a significant association between social support and antenatal anxiety.

A longitudinal study conducted in the United Kingdom has shown that women receiving greater social support from their family reported feeling significantly less anxious; one standard deviation (SD) increase in social support (SS) from the family is associated with a 0.044 SD decrease in anxiety (P=0.029). Also, a one SD increase in social support from the

husband/partner was associated with a 0.033 SD decrease in STAI-State scores (P=0.0051) (Akiki et al., 2016).

Another finding from a longitudinal study in Bangladesh (n=720) (β: -1.144, P < 0.05) (Nasreen et al., 2011) and Taiwan (n=158, (β=−0.79, 95% CI (−1.16, −0.42), P<0.05) (Huang et al., 2019) reported that social support during pregnancy was negatively associated with anxiety. A cross-sectional study conducted in Iran (n=372) (r=-0.456, p<.001) (Shafaie et al., 2018) and Pakistan (n=500, r=-0.433, P<0.001) (Waqas et al., 2015) among pregnant women revealed that there was a significant negative correlation between social support and anxiety during pregnancy. Similarly, a negative correlation was also reported from a longitudinal study conducted in Canada (n=2052, r= -7.34, P <0.01) (Glazier et al., 2009).

A facility-based study conducted in Greece on pregnant mothers concluded that there was no significant correlation between good social support and antenatal anxiety elation (n=165, β= 0.131, 95% CI (0.19, 2.37), P>0.05) (Gourounti et al., 2013). A facility-based longitudinal study conducted in Canada reported social support did not have significant relation with antenatal anxiety (n=5271, β=0.08, 95% CI (0.01, 0.15), P>0.05) (Dunkel Schetter et al., 2016).

Association between social support and self-harm during pregnancy

Due to the small number of studies examining self-harm and low social support among pregnant women, no meta-analysis was conducted on this specific association, thereby included in the narrative analysis. Three cross-sectional studies examined the association between social support and self-harm during pregnancy. A cross-sectional study conducted in South Africa among randomly selected pregnant women reported a significant association between social support and suicidal ideation and behaviour (SIB) during pregnancy (n=376, AOR: 1.07, 95% CI (1.01, 1.15), P<0.05), suggesting a protective effect of good social support (Onah et al., 2017). A cross-sectional study conducted in Brazil, which employed a consecutive sampling process to recruit pregnant women, reported that women with low social support were three times more likely to develop self-harm compared with their counterparts (n=871, AOR: 3.03, 95% CI (1.78, 5.26) (Pinheiro et al., 2012). Finally, a study conducted in India among urban pregnant women found that those who reported low perceived social support had higher odds of developing current suicidal ideation (n= 462, AOR: 1.17, 95% CI (1.02, 2.35) (Supraja et al., 2016). However, a cross-sectional study conducted in Brazil among 255 pregnant mothers

found no significant association between social support and self-harm (AOR: 1.75, 95% CI (0.62, 5) (e Couto et al., 2016).

Meta-analysis of the association between low social support and antenatal depression

Drawing upon data from 45 studies identified, a meta-analysis was conducted to examine the association between low social support and antenatal depression. Of these 45 studies, 36 (80%) were conducted at the health facility level, and 26 (57%) employed a cross-sectional study design. Also, 29 (64%) of the studies used the Edinburgh Postnatal Depression Scale (EPDS) as a screening tool to measure depression. From the identified 45 studies, a relatively large number of papers (20 [44.4%]) were published between the year 2016-2019 (Table 4.1).

Except for eight studies (Bisetegn et al., 2016; Dong et al., 2013; Jesse et al., 2005; Li et al., 2017; Pajulo et al., 2001; Rwakarema et al., 2015; Sahile et al., 2017; Sheeba et al., 2019), all the remaining 37 studies included in the meta-analysis revealed low social support has a significant positive association with the risk of antenatal depression. The result of the meta-analysis showed low social support has a significant positive association with antenatal depression (AOR: 2.00 (95% CI: 1.71, 2.34) (Figure 4.3). As the eggers test was found significant (p=0.033), the final pooled effect size was corrected using Duval and Tweedie's trim and fill analysis (AOR: 1.18 (95% CI: 1.01, 1.41). Due to the observed significant heterogeneity (I^2= 98.9%, Q= 3962.35, df =44, P<0.001), a random effect meta-analysis model was employed. To identify the possible sources of heterogeneity, variables such as publication year (Coefficient: -0.019, P: 0.301) and sample size (Coefficient: -0.0001, P: 0.019) were investigated via a univariate meta-regression model, and the sample size was statistically significant and identified as one of the possible sources of heterogeneity.

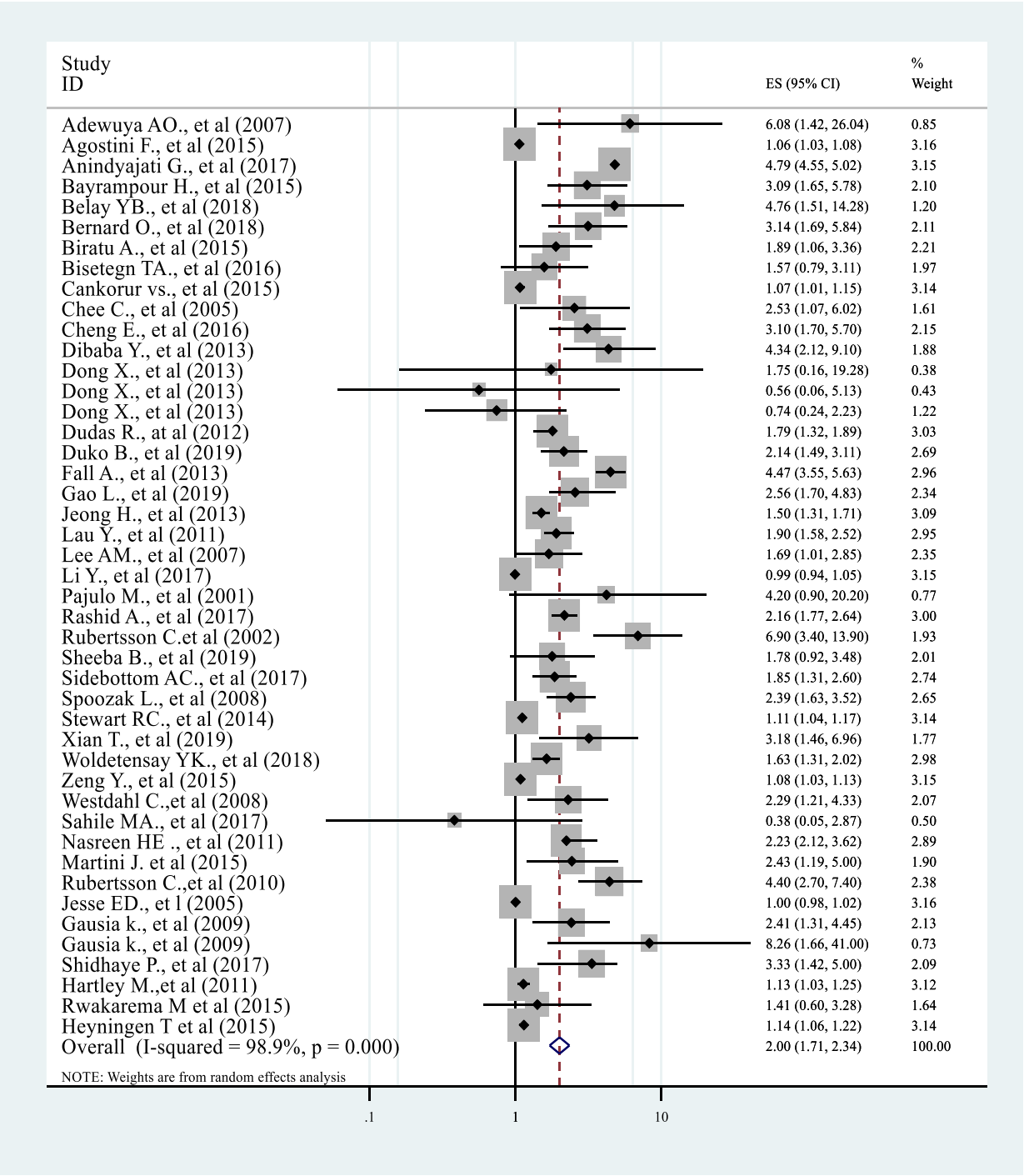


Figure 4.3: Forest plot indicating POR of low social support as a risk factor for antenatal depression.

Subgroup Analysis of the association between low social support and antenatal depression

Due to the reported high heterogeneity index among studies examining the association between low social support and antenatal depression, a subgroup analysis was conducted using characteristics like study setting, the income of countries, study design, sample size, publication year and tools used.

The subgroup analysis conducted based on the study setting revealed a higher POR of low social support among studies conducted in a community setting (POR=2.21, 95% CI: 1.25, 3.93, I^2 =99%, Q= 792.08, P<0.001) compared with facility-based studies (POR=2.21, 95% CI (1.25, 3.93), $I^{2=}$93.0%, Q= 502.3, P<0.001). In addition, a higher POR was estimated in the years 2000-2005 (POR=4.37, 95% CI (2.20, 8.71, I^2=36.0%, P<0.001) followed by the years 2006-2010 (POR=2.20, 95% CI (1.31, 3.71), I^2 =88.1%, P<0.001). Regarding the median sample size, the POR of low social support was relatively higher among studies with a sample size greater than 520 (POR=2.01, 95% CI (1.59, 2.55), I^2=88.9%, P<0.001) (Table 4.3).

Table 4.3: Subgroup analysis of odds of low social support in the association between social support and antenatal depression (N= 45, 2000-2019) (Random effect model).

Variable	No of studies	Pooled AOR (95% CI)	Heterogeneity within the study (I^2 and Q)	
			Q value	I^2, P-value
Study setting				
Facility	36	1.63(1.49, 1.77)	502.3	93.0%, p<0.001
Community	9	2.21(1.25, 3.93)	792.0	99.0%, p<0.001
Income of country				
High-income	16	1.98(1.72, 2.27)	367.	95.9%, p<0.001
Middle-income	14	1.33(1.19, 1.50)	115.7	88.8%, p<0.001
Low-income	15	2.26(1.36, 3.76)	1431.5	99.0%, p<0.001
Study design				
Cross-sectional study	26	1.84(1.4, 2.41)	3534.2	99.3%, p<0.001
Longitudinal study	19	2.1(1.78, 2.48)	339.6	94.7%, p<0.001
Median Sample size†				
<520	30	1.99(1.63, 2.41)	3833.8	99.2%, p<0.001
>=520	15	2.02(1.59, 2.55)	126.5	88.9%, p<0.001
Publication year				
2000-2005	3	4.37(2.20, 8.71)	3.13	36.0%, p=0.209
2006-2010	7	2.20(1.31, 3.71)	50.3	88.1%, p<0.001
2011-2015	15	1.67(1.43, 1.95)	295.8	95.3%, p<0.001
2016-2019	20	2.06(1.43, 2.97)	2598.4	99.3%, p<0.001
Depression assessment tool				
Screening	41	2.07(1.74, 2.46)	3940.9	99.0%, p<0.001
Diagnostic	4	1.29(1.09, 1.52)	19.25	84.4%, p<0.001

† Cut of point is based on the Median of sample size (median=520)

Sensitivity analysis

A leave-one-out sensitivity analysis was conducted among studies examining the association between low social support and antenatal depression to help identify the effect of a single study on the overall pooled estimate. The sensitivity analysis using the random-effects model resulted in the POR ranges from 1.94 (95% CI: 1.66, 2.28) to 2.07 (95% CI: 1.71, 2.49). The sensitivity analysis shows that none of these studies was found to have substantially altered the overall results of the analysis.

Meta-analysis of the association between low social support and antenatal anxiety

A meta-analysis was also conducted, drawing upon data reported from 9 papers that examined the association between low social support and antenatal anxiety. Of these studies, 8 were institution-based cross-sectional studies, 6 (66.6%) used longitudinal study design and five reported data from high-income countries.

All the studies included in this meta-analysis found that low social support has a significant association with the risk of antenatal anxiety (Bayrampour et al., 2015; Cheng et al., 2016; Gao et al., 2019; Lee et al., 2007; Marchesi et al., 2014; Martini et al., 2015; Nath et al., 2019; Tang et al., 2019; van Heyningen et al., 2017). The pooled estimate found that low social support has a significant positive association with antenatal anxiety (AOR: 2.28 (95% CI: 1.47, 3.54) (Figure 4.4). As the eggers test was found significant ($p<0.001$), the final pooled effect size was corrected using Duval and Tweedie's trim and fill analysis (AOR: 1.97 (95% CI: 1.34, 2.92). Since we found significant heterogeneity among the studies (I^2= 90.0%%, Q= 79.82, df =8, P<0.001) a random effect meta-analysis model was applied. To identify the possible sources of heterogeneity, variables such as publication year (Coefficient: 0.02, P: 0.688) and sample size (Coefficient: 0.0002, P: 0.261) were investigated using univariate meta-regression models, but none of these variables was found to be statistically significant.

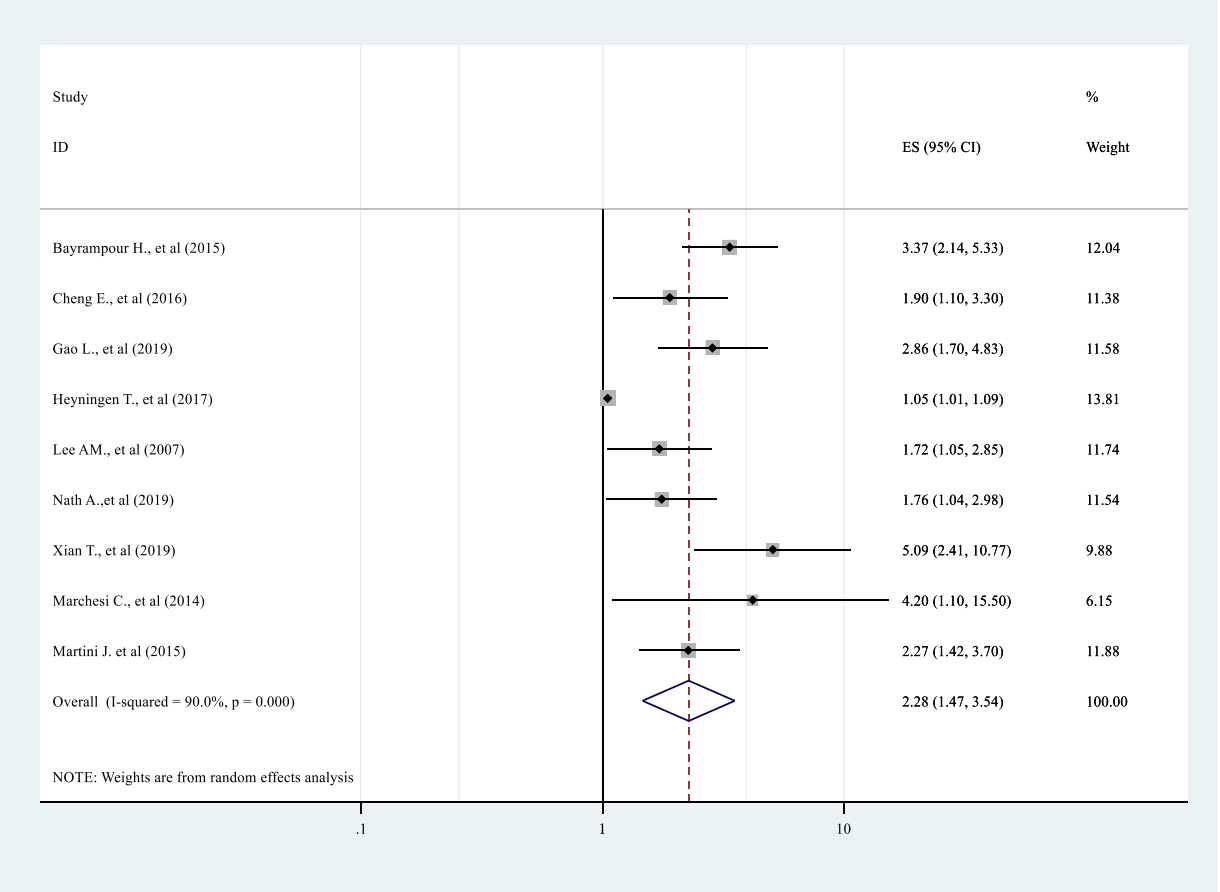


Figure 4.4: Forest plot indicating POR of low social support as a risk factor for antenatal anxiety.

Subgroup Analysis of the association between low social support and antenatal anxiety

Due to the reported high heterogeneity index among studies examining the association between low social support and antenatal anxiety studies, a subgroup analysis was conducted using characteristics like study setting, the income of countries, study design, sample size, publication year and tools used.

The sub-group analysis undertaken based on the design of the study revealed a higher POR of low social support among studies conducted using a longitudinal study design (POR: 2.59, 95% CI (1.87, 3.57), I^2=44.2%, Q=8.97, P=0.11). In addition, a sub-group meta-analysis conducted based on the income of countries reported that higher POR of low social support was among high-income countries, determined a POR of 2.34 (95% CI (1.76, 3.11), $I^{2=}$ 23.6%, Q=5.23, p=0.264) (Table 4.4).

Table 4.4: Subgroup analysis of odds ratios of the association between low social support and antenatal anxiety (N= 9, 2000-2019) (Random effect model).

Variable	No of studies	Pooled AOR (95% CI)	Heterogeneity within the study (I^2 and Q)	
			Q value	I^2, P-value
Income of country				
High-income	5	2.34(1.76, 3.11)	5.23	23.6%, p=0.264
Low & middle-income	4	2.15(1.06, 4.38)	34.55	91.3%, p<0.001
Study design				
Cross-sectional study	3	2.27(1.46, 3.53)	17.68	88.7%, p<0.001
Longitudinal study	6	2.59(1.87, 3.57)	8.97	44.2%, P=0.11
Median Sample size‡				
<376	4	2.28(1.72, 3.02)	2.77	0%, P=0.429
>=376	5	2.17(1.16, 4.07)	49.53	91.9%, p<0.001
Publication Year				
2015+	7	2.27(1.36, 3.78)	72.45	91.7%, P<0.001
Before 2015	2	2.16(1.007, 4.63)	1.53	34.7%, P=0.216

‡ Cut of point is based on the Median of sample size (median=376).

Publication bias

With regards to the literature reporting on the association of low social support with antenatal depression and antenatal anxiety, a funnel plot for both meta-analyses appeared asymmetrical, indicating the presence of publication bias and Egger's test for antenatal depression (P=0.033) and antenatal anxiety (P<0.001) also showed evidence of publication bias. In response, Duval and Tweedie's trim and fill analysis was conducted. After adjusting for the publication bias, the trim and fill analysis reported an estimate of pooled AOR of low social support reduced from AOR: 2.00 (95% CI: 1.47, 3.54) to AOR: 1.18 (95% CI: 1.01, 1.41) for antenatal depression (Figure 4.5) and from AOR: 2.28 (95% CI: 1.47, 3.54) to AOR: 1.97 (95% CI: 1.34, 2.92) for antenatal anxiety (Figure 4.6).

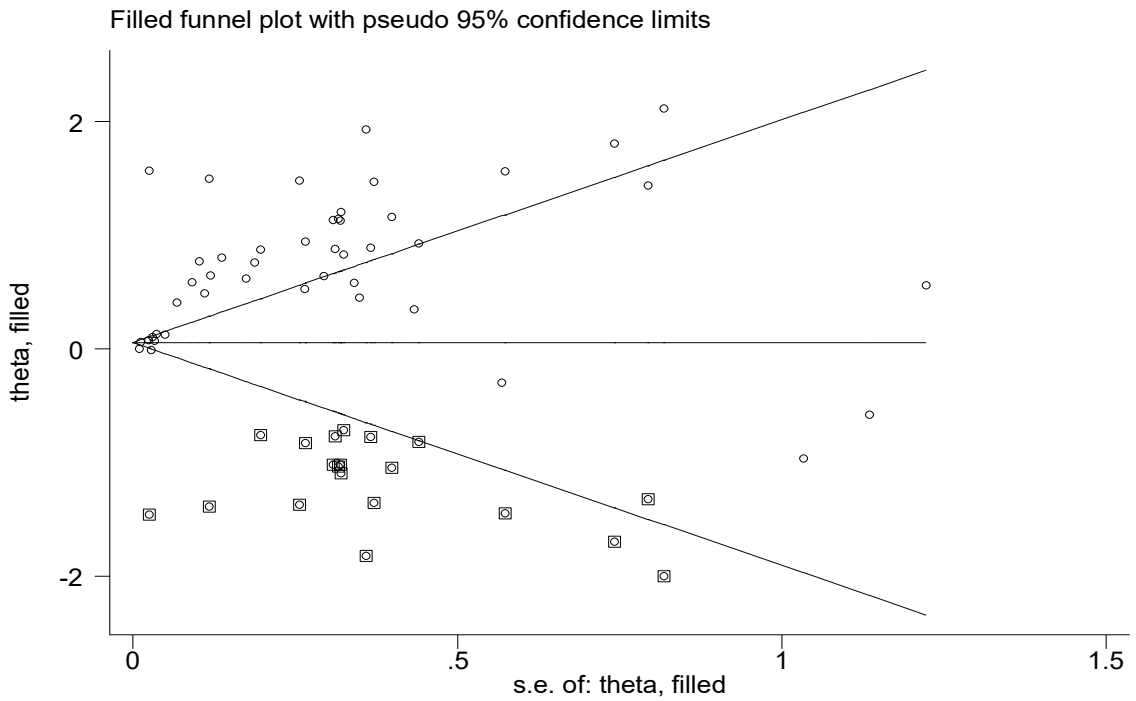


Figure 4.5: Tweedie's and Duval's trim and fill analysis on studies examining the association between low social support and antenatal depression.

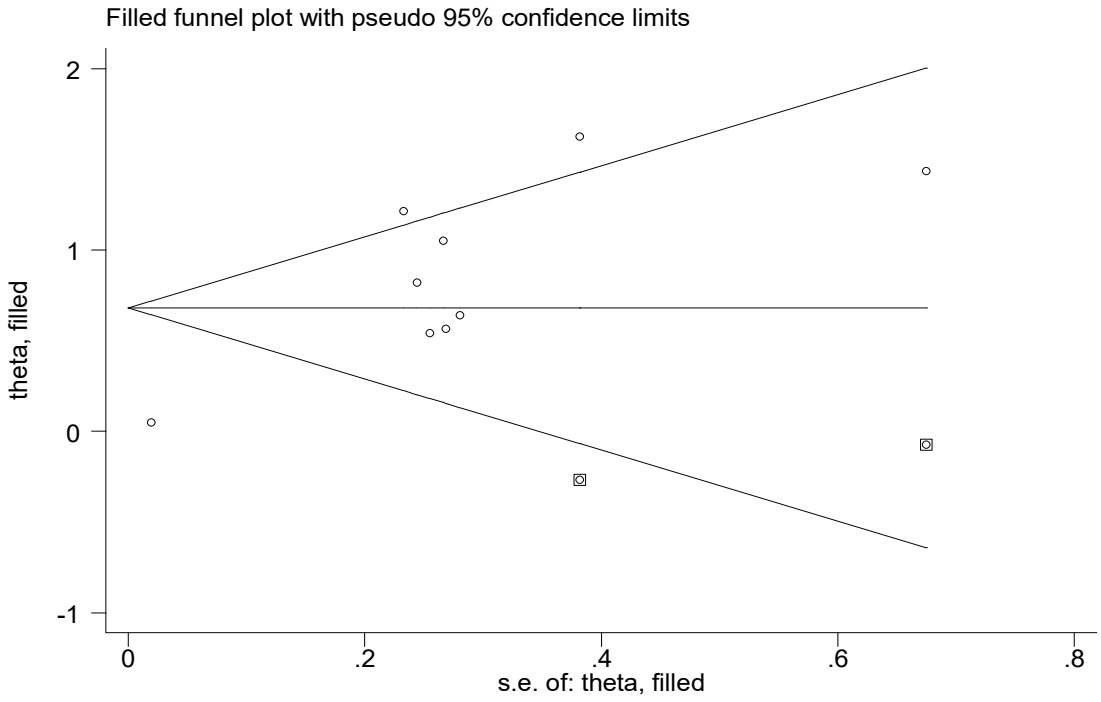


Figure 4.6: Tweedie's and Duval's trim and fill analysis on studies examining the association between low social support and antenatal anxiety.

Discussion

Our study reports the findings of the first systematic review and meta-analysis examining the relationship between social support and mental illness (depression, anxiety, and self-harm) during pregnancy, revealing a number of interesting findings.

Our review identified that pregnant women who received low social support are more likely to develop mental illness compared to pregnant women who received good social support. Among studies included in the narrative synthesis, a majority of studies reported significant positive associations between low social support and antenatal depression [14/15 (93.3%) studies], low social support and antenatal anxiety [6/8 (75%) studies] and low social support and self-harm [3/4 (75%) studies] during pregnancy. Further, the pooled estimate of the meta-analysis shows that low social support had a significant positive association with antenatal depression and antenatal anxiety. Pregnant women with low social support may not have someone to confide in, obtain important information/advice from, or help reduce the negative emotions associated with a distressing situation, and as a result, they might be exposed to stress and may later develop depression (Thoits, 1986). Also, pregnant women with low social support are 'mobilise the community and poor in interacting with the social environment, and as a result, they might be exposed to loneliness, become less in emotional and stress coping ability and later become more anxious (Alden & Mellings, 2004; Thoits, 1986).

Support for our findings comes from various epidemiological studies conducted in general populations that have revealed low social support was associated with the onset and relapse of depression among individuals with a previous history of mental illness (Paykel, 1994), and seasonal change of mood disorder in UK (Michalak et al., 2003). Also, low social support has a significant positive relationship with postnatal depression among a representative sample of Australian women (Chojenta et al., 2012).

A global level systematic review found that social support is also associated with improved mental health and decreased levels of depressive symptoms among female heads of households (Khazaeian et al., 2017). Good social support (Stuart-Parrigon & Stuart, 2014) may play a protective role against mental illness during pregnancy. Pregnant women with good social support are more likely to have improved mental, psychological, and emotional health than their counterparts (Cohen & Wills, 1985; Dunkel Schetter, 2011). Also, another research finding showed that individuals with constructive social relations and good social support enjoy

more efficient communication skills, helping provide some protection from depression and other mental illnesses (Ghasemipoor & Jahanbakhsh, 2010). On the other hand, good social support protects people from illnesses (Kamran, 2009) and can help provide an additional coping mechanism for stress (Stuart-Parrigon & Stuart, 2014).

A randomized control trial (RCT) examining the psychosocial benefits of a telephone support program for pregnant women in the metropolitan city on the South Island of New Zeeland revealed the intervention group at 34 weeks had lower stress scores, lower trait anxiety and less depressed mood than the control group (Bullock et al., 1995). However, another randomized controlled trial conducted in North East England involving low risk nulliparous pregnant women found that the provision of additional telephone support by a midwife did not significantly reduce anxiety levels ($p = 0.68$) (Snaith et al., 2014). Similarly, another RCT conducted in the US among pregnant women with a history of at least one spontaneous perinatal loss found that providing interventions like home visits and support by nurses found no significant decrease in anxiety scores between the groups post-intervention ($p = 0.66$) (Côté-Arsenault et al., 2014).

As presented in sub-group analyses, among studies examining the association between low social support and antenatal depression, the pooled odds ratio of low social support was relatively higher among studies conducted in low-income countries compared with studies conducted in high-income countries. This might be due to the fact that most women living in low-income and middle-income countries face financial and economic challenges, which might expose them to additional stress and social exclusion compared with pregnant women living in high-income countries. Also, involvement in social activities may require money to attend events. So social exclusion and self-isolation of individuals from the social environment might lead them to feelings of loneliness and other psychological problems (Bourdieu, 1982). This concept was supported by a study conducted in Germany, which identified that socially disadvantaged persons more often report poor social networks and social support compared with their counterparts (Jenkins et al., 2012).

Finally, there was a significant level of heterogeneity amongst the studies examining the association between social support and either antenatal anxiety or antenatal depression. This high level of heterogeneity could be due to the different conceptualisation and measurement of social support employed in the studies. Our review identified 22 different types of social

support assessment tools used to measure social support. This shows a difference in the understanding of social support across many individuals and community members who were from different countries with different socio-economic settings. The lack of comprehensive agreement regarding the best method to measure social support is one of the identified challenges across the current literature (Berkman, 2000). As a result, working towards a unified social support measurement would be helpful.

Implications for future research and clinical practice

Our review found that low social support has significant associations with the risk of mental health problems (depression, anxiety, and self-harm) during pregnancy. This suggests maternal health professionals need to have discussions with pregnant women regarding their level and source of social support. Policymakers and other relevant stakeholders should consider helping develop community-based social support programs for pregnant women to effectively integrate alongside other commonly used maternal health services. Reverse causation is possible between low social support and mental health problems during pregnancy. Therefore, to address the issue of reverse causation, future longitudinal studies, which can ensure the temporal order of events, is recommended. Finally, future interventional research is needed to further explore the effect of social support in preventing mental health problems during pregnancy.

Limitations

There were some limitations to our study. The search was restricted to only include studies published in English language, which may lead to publication bias. Due to variations in diagnostic approaches, the assessments used for social support, depression and anxiety may be prone to measurement bias. However, we have addressed the issue of heterogeneity and publication bias during our analysis, which provides better estimates of the associations between social support and depression and anxiety during pregnancy.

Conclusion

Low social support has significant associations with depression, anxiety, and self-harm during pregnancy. Strong social support may act to safeguard pregnant women from depression, anxiety, and self-harm. Maternal health professionals need to discuss with pregnant women the level and source of available social support and monitor pregnant women's mental health

status. Maternal health professionals may also wish to consider encouraging the social network of pregnant women to improve the social support being given. Policymakers and other relevant stakeholders should consider helping develop community-based social support programs for pregnant women that can be effectively integrated with other commonly used maternal health services. Finally, future research in this area should consider interventional studies that explore the effectiveness of social support in preventing mental illness during pregnancy.

Chapter Summary

This chapter covers a global level systematic review and meta-analysis of studies assessing the relationship between social support and antenatal mental health problems such as depression, anxiety and self-harm. Also, this chapter highlighted the available social support measures available in the current literature. The review found a significant association between low social support and antenatal depression, anxiety, and self-harm. Finally, the discussion and conclusion of the study were presented.

The following chapter will cover a study examining the prevalence and determinants of low social support among Australian women using ALSWH data.

Chapter 5: Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study

All results presented in this chapter are based on analyses of data obtained from the ALSWH. Information on the ALSWH has been provided in Chapter 3. This study was undertaken to address research question 2, outlined in chapter one, which refers to the prevalence and determinants of low social support among pregnant Australian women. Based on the results indicated below, seven percent of women in Australia reported low social support during their pregnancy. Also, having mental health problems (depressive and/or anxiety symptoms), experiencing stress, having a low socio-economic status, and not being in a relationship status are all significant determinants of low social support during pregnancy. Maternal health professionals can use this information to screen pregnant women at risk of receiving low social support as well as develop policies to help enhance antenatal social support.

The results presented in this chapter have been published in the *Reproductive Health* Journal:

> **Bedaso, A**., Adams, J., Peng, W., & Sibbritt, D. (2021). Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study. *Reproductive Health*, *18*(1), 1-11. https://doi.org/10.1186/s12978-021-01210-y.

Abstract

Background: Pregnancy is a time for women in which the need for social support is crucial. Social support reduces stressors and improves the emotional and physical well-being of pregnant women. Women receiving low social support during pregnancy are at risk of substance use, developing mental illness, and adverse birth outcomes. The current study aims to determine the prevalence and determinants of low social support during pregnancy among Australian women.

Methods: Data were obtained from the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH), and those who reported being pregnant (n=493) were included in the current analyses. Social support was assessed using Medical Outcomes Study Social Support index (MOSS). A logistic regression model was applied to identify determinants of low social support separately for each MOSS domain.

Result: The study found that 7.1% (n=35) of pregnant women reported low social support. Significant determinants of low emotional support were non-partnered (AOR= 4.4, 95% CI: 1.27, 14.99), difficulty managing on available income (AOR= 3.1, 95% CI: 1.18, 8.32), experiencing depressive symptoms (AOR= 8.5, 95% CI: 3.29, 22.27) and anxiety symptoms (AOR= 2.9, 95% CI: 1.26, 7.03). Significant determinants of low affectionate support were suffering from depressive symptoms (AOR= 5.3, 95% CI: 1.59, 17.99), having anxiety symptoms (AOR: 6.9, 95% CI: 2.21, 22.11) and being moderately/very stressed (AOR: 3, 95% CI: 1.17, 7.89). Significant determinants of low tangible support were difficulty managing available income (AOR= 3, 95% CI: 1.29, 6.95) and being depressed (AOR= 2.8, 95% CI: 1.48, 5.34).

Conclusion: The study revealed that 7.1% of pregnant women reported low social support. Having mental health problems, being stressed, being from low socio-economic status and being non-partnered are significant determinants of low social support during pregnancy. Maternal health professionals and policymakers can use this information to screen pregnant women at risk of receiving low social support and improve the level of support being provided.

Keywords: Low social support, Emotional support, Affectionate support, Tangible support, mental health, women, Pregnancy.

Background

Pregnancy is an important but emotionally sensitive time for most women, and it is also accompanied by changes in physical appearance, role and lifestyle (Davalos et al., 2012; Smith et al., 2011). Such changes may have an impact on the attitude, decision making and behaviour of the pregnant mother in undertaking the social responsibility that comes with pregnancy and motherhood (Sabroza et al., 2004). These changes during pregnancy may be exacerbated by financial problems, relationship issues and lack of social support (Brown et al., 2011; Diego et al., 2006; Divney et al., 2012). Thus, to tackle these challenges, the need for social support during pregnancy is vital (Da Costa et al., 2000).

Social support is defined as the provision of emotional (e.g. caring), or informational (e.g. notifying someone of important information) support, instrumental (e.g. helping with housekeeping), tangible (e.g. practical support like financial aid), and/or psychological support for somebody by the social network of family members, friends, and community members (Cohen et al., 2004). It is an assistance from one individual or a social network that is given to another individual, which produces an instant or later positive response in the recipient (Hupcey, 1998). Social support is assumed to influence through two potential mechanisms (i.e. main effects and buffering mechanism) (Cohen & Wills, 1985; Dunkel Schetter, 2011; Orr & Miller, 1997). As the main effect, social support and social network provide a sense of belonging and stability, resulting in improved self-esteem and reducing the risk of stress and mental illness (Cohen & Wills, 1985). Social support can act as a buffer by providing access to additional resources to enhance suitable coping mechanisms for pregnant women to deal with stressful events (Cohen & Wills, 1985; Dunkel Schetter, 2011).

Providing strong social support improves emotional and physical well-being (Feldman et al., 2000), strengthens social relationships, promotes health (Cohen et al., 2000), and enhances the ability of pregnant women to cope with stress (Giesbrecht et al., 2013; Rini et al., 2006). Also, social support can reduce functional impairment among individuals with depressive symptoms, and increase the likelihood of recovery, thereby improving the overall quality of life (QOL) (Da Costa et al., 2006; Robertson et al., 2004). It has been suggested that social support interventions and social participation are effective in preventing antenatal and neonatal adverse birth outcomes (Glazier et al., 2009; Zachariah, 2009). Furthermore, social support can improve self-confidence, increase resistance to infections, and contribute to a healthier lifestyle (Landman-Peeters et al., 2005; Solar & Irwin, 2007). The vast bulk of research examining the

relationship between social support and pregnancy outcomes over the past thirty years have shown individuals who receive good social support have greater longevity than those with poor social support (Orr, 2004).

Previous studies have shown that low social support is a risk factor for depression during pregnancy and post-birth (Morikawa et al., 2015; Spoozak et al., 2009; Werner et al., 2015), as well as a greater risk of giving birth to an underweight infant (Theo Mutale et al., 1991). There appears to be a significant association between a lack of social support and drinking alcohol, smoking tobacco, and illicit drugs use during pregnancy (Degen et al., 1993; Dunnagan et al., 2003; Shishehgar et al., 2013) and pregnant women who report anxiety disorder, who smoke tobacco, who live without a partner, who have an unplanned pregnancy and/or who have a low socio-economic status also report low social support (Peter et al., 2017). Furthermore, a women's level of education and length of relationship with their partner are also important determinants of social support during pregnancy (Emmanuel et al., 2011).

Despite all this evidence, no study has addressed the prevalence and determinants of low social support during pregnancy among Australian women. Therefore, the purpose of the current study intended to fill this research gap by examining the prevalence and determinants of low social support during pregnancy amongst a sample of Australian pregnant women.

Methods and Material

Population, sampling and data collection

Data were obtained from the Australian Longitudinal Study on Women's Health (ALSWH) (Brown et al., 1999; Loxton et al., 2018). ALSWH was established in 1996 with the recruitment of 40,000 women in three different age cohorts (women born between 1973-78, 1946-51 and 1921-26). The ALSWH project is designed to observe changes in women's health through follow-up, provide information that will elucidate cause-and-effect relationships and examine the effects of changes in policy and practice.

ALSWH study participants were selected randomly (with an over-sampling of women living in rural and remote areas, who were sampled at twice the rate of women in urban areas) using the national health insurance database (now Medicare Australia). Information from participants for the 1873-78 cohort was gathered via mailed surveys on a three-year intervals. The age of participating women of the 1973-78 cohort was between 18–23 years when recruited in 1996

and were broadly representative of the population of similar age Australian women at that time (Lee et al., 2005). Details about the ALSWH project have been published elsewhere (Brown et al., 1999; Loxton et al., 2018). The sample for this study was drawn from Survey 6 of the 1973–78 cohort. From the 8010 women who completed Survey 6 (aged 34-39 years), those who reported being pregnant (n=493) were included in the current analysis.

Variables and measurement

Social support provided for pregnant women was the outcome variable, assessed using the Medical Outcomes Study Social Support index (MOSS) (Donald Sherbourne & Stewart, 1991). MOSS has an overall index of 19 items and four functional support subscales: emotional/informational support (involves caring, love and empathy) (8 items); tangible support (the provision of material aid or behavioral assistance) (4 items); and affectionate support/positive social interaction (involving expressions of love and affection/the availability of other persons to do fun things) (7 items). Each of the 19 items has a 5-point Likert response (ranging from: 'none of the time'= 1 to 'all of the time'= 5) assessing the availability of support. For the purpose of the current analysis, each domain of social support was categorized into high ("all of the time" and "most of the time") and low ("a little of the time/none" and "some of the time") social support (Sherbourne & Stewart, 1991).

Study participants were requested to specify their marital status as either "married," "never married," "de facto," "separated," "divorced," or "widowed." For the current analysis, groups were re-categorized into either "partnered" (married or de facto) or "non-partnered" (single, divorced, separated, or widowed). Postcode of residence was used to categorise respondents as living in either "major cities of Australia", "inner regional Australia", "outer regional Australia", or "remote or very remote Australia".

Income stress was measured via how respondents reported their ability to manage on available income, with response options: "impossible", "difficult all of the time", "difficult some of the time", "not too bad", or "easy". For the purposes of analyses, these options were collapsed into two categories, "impossible or difficult all or some of the time" and "not too bad or easy".

The respondents were questioned about their alcohol consumption. Based on their responses, the women were then categorised as being either a "non-drinker" or a "drinker" of alcohol. Similarly, based on their response to a question regarding cigarette smoking, the women were

categorised as being either a “non-smoker” or a “current smoker”. To assess illicit drug use, women were provided with a list of drugs and asked if they had used any of them during the past 12 months. The list of drugs included Marijuana; Amphetamines; LSD; Hallucinogens; Tranquillizers; Cocaine; Ecstasy/designer drugs; Inhalants; Heroin; Barbiturates; and Steroids. Based on their responses, the women were classified as being either a “non-user” or a “user” of illicit drugs.

The level of stress in the last 12 months among study participants was assessed using the Perceived Stress Questionnaire, which has been developed and validated for the ALSWH study (Bell & Lee, 2002). The tool examined the level of perceived stress in specific areas of life, including study, relationships and own health. An overall mean stress score was determined, which ranges from 0 (no stress) to 4 (extreme stress). The Perceived Stress Questionnaire has good internal reliability (α=0.75) (Bell & Lee, 2003; Bell & Lee, 2006).

Depression was assessed using the 10-item Center for Epidemiological Studies Depression (CES-D-10) scale, with a possible range of 0-30 and Cronbach’s alpha of 0.79. A cutoff point $\geq$ 10 from the total score indicates the presence of depressive symptoms (Andresen et al., 1994). CES-D-10 has been used to examine depressive symptoms during pregnancy with good reliability and validity (Canady et al., 2009; Holzman et al., 2006; Marcus et al., 2003; Mosack & Shore, 2006; Seto et al., 2005). The anxiety symptoms among pregnant mothers were assessed using the 9-item (yes/no) Anxiety subscale of the Goldberg Anxiety and Depression scale (GADS). A score of GADS greater than 6 indicates the presence of anxiety symptoms and has good reliability with Cronbach’s alpha of 0.77 (Goldberg et al., 1988).

Data analysis

Data were analysed using SPSS version 22. Chi-square tests were used to test for crude associations between domains of social support and socio-demographic, mental health, and lifestyle behaviour related factors. Independent sample t-test analyses were performed to examine the difference in the mean age of pregnant women for each domain of social support. The prevalence of low social support in each domain was calculated for each of the independent variables. During the bivariate analyses, variables with a p-value less than 0.25 entered into a multiple logistic regression model. In the final model, significant determinants of low social support were identified using a backward stepwise elimination approach. The strength of association was measured by adjusted odds ratios (AOR) with 95% confidence intervals. The

significance level was set at $p < 0.05$. The model fitness test was conducted using the Hosmer and Lemeshow goodness of fit test (Hosmer & Lemeshow, 2000).

Ethics approval and consent to participate

The ALSWH has been granted ethics clearance by the Human Research Ethics Committee (HREC) of the University of Newcastle (#H-076-0795) and the University of Queensland (#2004000224). Study participants were involved voluntarily and provided written informed consent. The confidentiality of study participants' information is firmly monitored by ALSWH staff. An approval letter for the current study was obtained from the Human Research Ethics Committee of the University of Technology Sydney (ETH20-5306).

Result

The mean age of participating women was 36.3 (standard deviation [SD] =1.42). The majority of participants (95.12%) were married/De facto, while 65% attained a university degree. The majority of these women (61.1%) lived in major cities, and 44.6% responded to having little or no difficulty in managing available income. The majority of the women (42%) were in the last trimester of their pregnancy, while 37.5% and 20.5% were in the second and first trimester, respectively (Table 5.1). The overall prevalence of low social support among pregnant women was 7.1% (n=35) (95% CI: 4.83, 9.39). Considering the specific domains of social support, the prevalence of low emotional support, low affectionate support and low tangible support in the current study was found to be 7.9%, 4.9%, and 10.9%, respectively. It was found that 25.1% of the women reported depressive and 20.9% reported anxiety symptoms.

Table 5.1: Demographic characteristics of participating pregnant women (n= 493).

Demographic characteristics	Number	Percent
Residence		
Major cities	286	61.1
Inner regional	103	22
Outer regional	66	14.1
Remote/Very remote[1]	13	2.8
Occupation		
Manager/professional/Assoc. Professional	294	59.8
No paid job	100	20.4
others[2]	97	19.8
Marital Status		
Married/ De facto (opposite sex)	468	95.12
Never Married	12	2.44
Divorced/separated[3]	12	2.44
Highest qualification achieved		
University	319	65
Certificate/Diploma	104	21.2
Year 12 or equivalent	43	8.8
Others[4]	25	5
Pregnancy month		
< 3 month	101	20.5
3-6 month	185	37.5
> 6 month	207	42
Able to manage on income available		
Difficult all the time/Impossible[5]	43	8.8
Difficult some of the time	118	24
Not too bad	219	44.6
It is easy	111	22.6

[1] Remote (n=6), Very remote (n=7)

[2] Others(Tradesperson or related worker(n=7), Advanced clerical or service worker (n=33), Intermediate clerical, sales/service worker (n=38), Intermediate production or transport worker (n=1), Elementary clerical, sales or service worker (n=11), Labourer or related worker (n=7))

[3] Divorced (6), Separated (6)

[4] Others (no formal education (n=2), Year 10 or equivalent (n=15), Trade/apprenticeship (n=8))

[5] Impossible (n=8), Difficult all the time (n=35)

The bivariate associations between demographic factors and domains of social support during pregnancy are shown in Table 5.2. Women with low emotional support were more likely to be non-partnered ($p < 0.001$) and report that their ability to manage on available income was impossible/difficult all of the time ($p < 0.001$). Similarly, women with low affectionate support were more likely to be non-partnered and found it difficult all of the time/impossible to manage on their available income ($p < 0.001$). Also, women with low tangible support were more likely to find it difficult all of the time/impossible to manage on their available income ($p < 0.001$) and were more likely to be non-partnered ($p = 0.002$). There was a significant mean age difference between participants with low/high emotional support ($p = 0.021$) and low/high affectionate support ($p = 0.021$).

Table 5.2: Demographic factors associated with low social support domains during pregnancy among Australian Women (n= 493).

Demographic Characteristics	Emotional support		p-value	Affectionate support		p-value	Tangible support		p-value
	Low (n=39)	High (n=453)		Low (n=24)	High (n=467)		Low (n=52)	High (n=439)	
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Residence									
Major cities	17 (43.5)	269 (59.4)	0.093	11 (45.8)	274 (58.6)	0.399	27 (52)	259 (59)	0.42
Inner regional	12 (30.7)	90 (19.8)		7 (29.2)	95 (20.4)		14 (27)	88 (20)	
Outer regional/Remote/very remote	9 (23.07)	70 (15.4)		5 (25)	74 (16)		10 (19)	68 (16)	
Marital Status									
Partnered	32 (82)	436 (96.2)	<0.001	20 (83.3)	447 (96)	0.006	45 (86.5)	422 (96)	0.002
Non-partnered	7 (18)	17 (3.8)		4 (16.7)	20 (4)		7 (13.5)	17 (4)	
Highest qualification achieved									
University	20 (51.3)	299 (66)	0.065	13 (54.2)	305 (65.5)	0.209	33 (63.5	285 (65)	3.12
Certificate/diploma or trade/apprenticeship	10 (25.6)	102 (22.5)		9 (37.5)	103 (22.1)		9 (17.3)	103 (23.6)	0.21
School only	9 (23.1)	51 (11.5)		2 (8.3)	58 (12.4)		10 (19.2)	50 (11.4)	
Pregnancy months									
< 3 month	6 (15.4)	95 (20.9)	0.62	4 (16.7)	97 (20.7)	0.96	8 (15.4)	93 (21.2)	0.246
3-6 month	17 (43.6)	168 (37)		11 (45.8)	174 (37.3)		25 (48.1)	160 (36.4)	
> 6 month	16 (41)	190 (41.9)		9 (37.5)	196 (42)		19 (36.5)	186 (42.4)	
Able to manage on income available									
Impossible/Difficult all of the time	13 (33.3)	30 (6.6)	<0.001	8 (33.3)	35 (7.5)	<0.001	13 (25)	30 (6.8)	<0.001
Difficult some of the time	9 (23.1)	109 (24.1)		3 (12.5)	115 (24.6)		14 (26.9)	103 (23.5)	
It is easy/not bad	17 (43.6)	313 (69.2)		13 (54.2)	317 (67.9)		25 (48.1)	305 (69.6)	
	Mean (SD)	**Mean (SD)**	**p-value**	**Mean (SD)**	**Mean (SD)**	**p-value**	**Mean (SD)**	**Mean (SD)**	**p-value**
Age	36.78 (1.5)	36.3 (1.40)	0.035	36.9 (1.42)	36.28 (1.4)	0.021	36.5 (1.44)	36.3 (1.41)	0.234

Note: p-value was based on chi-square test and t-test statistics

Table 5.3 shows the bivariate associations between mental health and lifestyle behaviour related factors and domains of social support. Women with low emotional support are more likely to report being depressed ($p < 0.001$), having anxiety ($p < 0.001$), being diagnosed or treated for depression in the past three years ($p < 0.001$), being diagnosed or treated for anxiety in the past three years ($p=0.021$) and being moderately/very stressed ($p < 0.001$) during pregnancy compared with participants getting high emotional support. Similarly, women with low affectionate support were more likely to report being depressed ($p < 0.001$), having anxiety ($p < 0.001$), being diagnosed or treated for anxiety in the past three years ($p=0.042$) and being moderately/very stressed ($p < 0.001$). In addition, women with low tangible support were more likely to report being depressed ($p < 0.001$), having anxiety ($p=0.001$), being diagnosed or treated for depression in the past three years ($p=0.002$), being diagnosed or treated for anxiety in the past three years ($p=0.007$) and being moderately/very stressed ($p =0.002$).

Table 5.3: Mental health and lifestyle behaviour related factors associated with low social support during pregnancy among Australian Women (n= 493).

Variables	Emotional support		p-value	Affectionate support		p-value	Tangible support		p-value
	Low (n=39)	High (n=453)		Low (n=24)	High (n=467)		Low (n=52)	High (n=439)	
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Alcohol use									
Non-drinker	15(38.5)	132(29.1)	0.185	11(45.8)	135 (28.9)	0.079	17(32.6)	130(29.6)	0.59
Low/High risk drinker	23(60)	320(70.6)		13(54.2)	330 (70.6)		34(65.4)	308(70.2)	
Tobacco smoking									
Current smoker	2(5.1)	20(44.2)	0.836	1(4.2)	21(4.5)	0.930	4(7.7)	18(4.1)	0.236
Non-smoker	37(94.9)	433(95.6)		23(95.8)	446(95.5)		48(92.3)	421(95.9)	
Illicit drug use									
Yes	27(69.2)	291(64.2)	0.531	17(70.8)	300(64.2)	0.510	37(71.2)	281(64)	0.308
No	12(30.8)	162(35.8)		7(29.2)	167(35.8)		15(28.8)	158(36)	
Depressive symptoms (CES-D 10)									
<10	7(17.9)	358(79)	<0.001	4(16.7)	361(77.3)	<0.001	24(46.2)	341(77.7)	<0.001
>=10	32(82.1)	90(21)		20(83.3)	101(21.7)		27(51.2)	95(21.6)	
Depression in the past 3 years (Previous Mental health)									
Yes	13(33.3)	45(10.1)	<0.001	5(20.8)	53(11.5)	0.172	13(25)	45(10.4)	0.002
No	26(66.7)	400(89.9)		19(71.2)	406(88.5)		39(75)	386(89.6)	
Anxiety symptoms (GAD)									
<6	15(38.5)	374(82.6)	<0.001	5(20.8)	384(82.2)	<0.001	32(61.5)	356(81.1)	0.001
>=6	24(61.5)	79(17.4)		19(79.2)	83(17.8)		20(38.5)	83(18.9)	
Anxiety in the past 3 years (Previous Mental health)									
Yes	6(15.4)	26(5.8)	0.021	4(16.7)	28(6.1)	0.042	8(15.4)	24(5.6)	0.007
No	33(84.6)	419(94.2)		20(83.3)	431(93.9)		44(84.6)	407(94.4)	

Stress									
Not at all/Somewhat stressed	22(56.4)	396(87.4)	<0.001	10(41.7)	407(87.2)	<0.001	37(71.2)	380(86.6)	0.002
Moderately/Very stressed	17(43.6)	55(12.1)		14(58.3)	58(12.8)		15(28.8)	57(13.4)	

Note: p-value was based on chi-square test statistics

The significant factors associated with low social support during pregnancy are presented in Table 5.4. After adjusting for confounding variables, multiple logistic regression found that non-partnered pregnant women (AOR= 4.4; 95% CI: 1.27, 14.99; p=0.019), difficulty all the time/impossible to manage on available income (AOR= 3.1; 95% CI: 1.18, 8.32; p=0.023), suffering from depressive symptoms (AOR= 8.5, 95% CI: 3.29, 22.27, p<0.001) and having anxiety symptoms (AOR= 2.9; 95% CI: 1.26, 7.03; p=0.013) were more likely to receive low emotional support. Pregnant women with depressive symptoms (AOR= 5.3; 95% CI: 1.59, 17.99; p=0.007), anxiety symptoms (AOR: 6.9; 95% CI: 2.21, 22.11; p=0.001) and moderately/very stressed (AOR: 3; 95% CI: 1.17, 7.89; p=0.023) were more likely to receive low affectionate support compared with their counterpart. Further, pregnant women who find it difficult all the time/impossible to manage on their available income (AOR= 3; 95% CI: 1.29, 6.95; p= 0.010) and those with depressive symptoms (AOR= 2.8; 95% CI: 1.48, 5.34; p=0.002) are around three times more likely to receive low tangible support.

Table 5.4: Determinants of domains of social support during pregnancy among Australian women (n=493), as determined by backward stepwise elimination approach using Multiple logistic regression modelling.

Variables	Emotional support		Affectionate support		Tangible support	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Marital Status						
Partnered	1.00		1.00		1.00	
Non-partnered	4.4 (1.27, 14.99)	0.019	4.1 (1.004, 17.15)	0.053	2.5(0.90, 7.08)	0.077
Able to manage on income available						
Impossible/Difficult all of the time	3.1 (1.18, 8.32)	0.023	-	-	3 (1.29, 6.95)	0.010
Difficult some of the time	1.2 (0.48, 3.11)	0.669	-	-	1.3 (0.63, 2.72)	0.479
It is easy/Not too bad	1.00				1.00	
Depressive symptoms (CES-D 10)						
<10	1.00		1.00		1.00	
>=10	8.5 (3.29, 22.27)	<0.001	5.3 (1.59, 17.99)	0.007	2.8 (1.48, 5.34)	0.002
Anxiety symptoms (GAD)						
<6	1.00		1.00		-	
>=6	2.9 (1.26, 7.03)	0.013	6.9 (2.21, 22.11)	0.001	-	-
Depression in the past 3 years (Previous Mental health)						
Yes		-	-	-	2(0.94, 4.34)	0.073
No		-	-		1	
Stress						
Not at all/Somewhat stressed	-		1.00		-	
Moderately/Very stressed	-	-	3 (1.17, 7.89)	0.023	-	-

Abbreviation: CI: Confidence interval, AOR: Adjusted Odds Ratio, CES-D 10: Center for Epidemiological Studies Depression scale, GAD: Goldberg Anxiety and Depression scale.

For low emotional support: variables entered in step 1; Residence, Marital status, highest qualification, able to manage on income available, current depressive symptoms (CESD- 10), current anxiety symptoms (GAD), Depression in the past 3 years, Anxiety in the past 3 years, and stress. P-value of Hosmer and Lemeshow test=0.939.

For low affectionate support: variables entered in step 1; Marital status, highest qualification, able to manage on income available, alcohol use, current depressive symptoms (CESD- 10), current anxiety symptoms (GAD), Depression in the past 3 years, Anxiety in the past 3 years, Stress. P-value of Hosmer and Lemeshow test=0.287.

For low tangible support: variables entered in step 1; Marital status, highest qualification, able to manage on income available, pregnancy months, Tobacco smoking, current depressive symptoms (CESD- 10), current anxiety symptoms (GAD), Depression in the past 3 years, Anxiety in the past 3 years, and stress. P-value of Hosmer and Lemeshow test=0.965.

Discussion

This study is the first to determine the magnitude and determinants of low social support during pregnancy among Australian women. The overall prevalence of low social support among pregnant women was 7.1%. The primary significant factors identified across the domains of low social support (i.e. low emotional, low affectionate and low tangible supports) were pregnant women's marital status, ability to manage available income, and mental health issues.

The current study found that those pregnant women who were not partnered were 4.4 times more likely to receive low emotional support compared with partnered pregnant women. Marital Partner is one of the important sources of emotional and affectionate support (Eaton, 1978) and support from a spouse and marital stability are important protective factors for the mental well-being of women during pregnancy (Freitas & Botega, 2002). Individual studies revealed that lack of support from a companion was more common among those who were not partnered (Figueiredo et al., 2006; Wahn & Nissen, 2008). Also, compared with non-partnered women, partnered women generally have numerous psychological and social advantages, though much of this may be limited to individuals living in a satisfactory relationship status (Kaplan & DeLongis, 1983) because pregnant women living in a violent relationship with their partner are more likely to receive less social support (Hamberger & Arnold, 1990). Our finding is supported by previous studies conducted in US (Cohen et al., 2014), Sweden (Wahn & Nissen, 2008) and Portugal (Figueiredo et al., 2006). However, a cross-sectional study conducted in Iran (n=320) (Rafiei et al., 2019) and Southern Brazil (n=871) (Peter et al., 2017) among a sample of pregnant women reported that marital status has no significant association with social support. The possible reason for this inconsistency might be due to the difference in the social support tool used, the demographic characteristics of participants, and the variation in the understanding of social support across individual participants because of the difference in socio-economic settings and cultural variation across countries. For instance, the study conducted in Iran includes participants with age $\geq$18 years (mean age 25.7 $\pm$ 5.5 years) and used a 23-item Vaux Social Support Questionnaire with three domains (support from family, friends and relatives). In contrast, our study includes participants with the age range of 34 to 39 years (mean age 36.3$\pm$1.42 years) and used 19 item MOSS scale which examined the emotional/informational support, affectionate support/positive social interaction and tangible support. Additionally, the non-significance of marital status in a study conducted in Iran might

be due to small number of non-partnered pregnant women (n=1) which can limit the power of the analysis.

Our study shows that pregnant women who have difficulty in managing available income are three times more likely to receive low emotional and/or low tangible support compared to those women who receive high emotional and/or high tangible support. This concept was supported by a study conducted in Germany, which identified that socially disadvantaged persons more often report poor social networks and social support compared with their counterparts (Weyers et al., 2008). Also, pregnant women with a higher household income predict better perceived social support based on reports of a study conducted in Mexico (Sciarra & Ponterotto, 1998). It is argued that individuals living in a low socio-economical class tend to have a more limited relational radius and prefer self-isolation from social events because involvement in social activities needs money to afford events which might lead them to self-neglect from society (Bourdieu, 1982). Moreover, withdrawal from society and having less friends may lead them to feeling of loneliness, and receive low emotional support and/or low affectionate support from the social environment, including family, friends and spouse (Nobis & El-Kayed, 2019).

Our study identifies depression during pregnancy as positively associated with the three domains of social support (i.e. low emotional/informational support, low affectionate/positive social interaction and low tangible support). The possible reason could be individuals with depression tend to withdraw themselves from social support and thus communicate with fewer family member/friends or they might feel more mistrustful and underestimate the level of existing support (Ibarra-Rovillard & Kuiper, 2011). Also, in the current study, participants were asked to report if they experienced depressive symptoms in the past week before the day of filling the questionnaire. Therefore, past week depressive symptoms could be strongly associated with low social support because being depressed may affect the perception of social support which might lead to underestimating the support received (Gariepy et al., 2016). Besides, depressed individuals induce negative responses and create interpersonal difficulties in their interactions with others, which can lead to avoidance or rejection by others (Ibarra-Rovillard & Kuiper, 2011; Oxman & Hull, 1997; Stice et al., 2004). The interpersonal accounts of depression also suggest that negative self-evaluation and social inadequacy manifested by depressed individuals disrupt social interactions (Joiner Jr, 2002; Rudolph et al., 2008) and as a result, an individual could be at risk of receiving low social support from family, friends and community. The finding in the current study supported by a cross-sectional study conducted in

Iran among pregnant women (n=320), which revealed a significant inverse relationship between depression and total social support score (p<0.001), family support (p<0.001), friends support (<0.001) and relative's support (p=0.003) (Rafiei et al., 2019).

Our study shows pregnant women who have anxiety symptoms are almost three and nine times more likely to receive low emotional and low affectionate support, respectively, as compared to those without anxiety symptoms. It is known that anxiety impairs social interaction (Peter et al., 2017), which explains why individuals with this disorder tend to be lonely and don't have the need to communicate. However, it is also possible that individuals who have anxiety symptoms are mainly involved by their own concerns and don't acknowledge the support received (Falcone et al., 2016). The finding of our study is supported by a cross-sectional study conducted in Southern Brazil (n=871) which found a moderate association between anxiety and affectionate, emotional, tangible, and informational domains; and a strong association with the positive social interaction domain (Peter et al., 2017). Additional support for our findings comes from another cross-sectional study conducted in Iran among pregnant women (n=320), which found a significant inverse relationship between antenatal anxiety and total social support score (p<0.001), family support (p<0.001) and friends support (<0.001) (Rafiei et al., 2019).

Being moderate/very stressed during pregnancy is significantly associated with low affectionate support, as shown in our study. The possible reason for this might be people with high levels of stress may be less able to keep contact and form strong social relationships with other people; thus, keeping others at a distance probably because they have a fear that they might convey their high stress to their social networks (Coyne & Downey, 1991). It is also possible that people with high levels of perceived stress underestimate the social support they receive and don't use support in a way that could benefit their psychological well-being (Ioannou et al., 2019).

Some limitations need to be considered when interpreting our study findings. First, the findings rely on self-reported data from study participants and therefore are prone to recall bias. Second, our findings are limited to pregnant women within the age range of 34-39 years (i.e. younger pregnant women not included), and this was because of undertaking a secondary analysis of a preexisting database. Third, our study didn't assess the social class of study participants; as a result, we couldn't stratify the marital status of study participants with their corresponding social class to see if it has an effect on marital status in predicting domains of social support.

Fourth, the use of a cross-sectional study design in the study raises concerns about reverse causation between low social support and depressive and/or anxiety symptoms. The cross-sectional study design cannot ensure the necessary time-based order of events. Specifically, if low social support (i.e. the exposure variable) precedes, it may cause individuals to develop depressive and/or anxiety symptoms (i.e. the outcome variable). In contrast, the early presence of depressive and/or anxiety symptoms may cause an individual to receive low social support. Therefore, reverse causation is possible, which creates a causal nexus that cannot be accurately modelled in a cross-sectional design. However, analyzing data collected from a nationally representative sample of pregnant women is the strength of our study.

Overall, the current study offers evidence of sociodemographic, psychosocial and lifestyle behavioural determinants of low social support. A better understanding of these risk factors will allow for more targeted screening to identify pregnant women at risk of getting low social support. Further research identifying the experience and details of additional risk factors for low social support amongst pregnant women is needed to help inform intervention strategies to improve the physical and psychological well-being of Australian pregnant women. Finally, to address the issue of reverse causation in the associations between low social support and depressive and/or anxiety symptoms, future longitudinal studies, which can ensure the temporal order of event, particularly over the different stages of pregnancy, is strongly recommended.

Conclusion

Seven Percent of pregnant women in Australia reported low social support during their pregnancy. Having mental health problems (depressive and/or anxiety symptoms), experiencing stress, being at a low socio-economic status, and not being in a relationship status are all significant determinants of low social support. Maternal health professionals can use this information to screen pregnant women at risk of receiving low social support as well as develop policies to help enhance the social support being given and the psychological well-being of pregnant women.

Chapter Summary

This chapter highlighted the background evidence, methodology and results of a study examining the prevalence and determinants of low social support among Australian pregnant

women using ALSWH data. The study found that around Seven Percent of pregnant women in Australia reported low social support during their pregnancy. Also, this chapter discusses the current findings with the previous international literature. Finally, the strengths, limitations and conclusion of the study were presented.

The following chapter will cover a study examining the association between social support and antenatal depressive and anxiety symptoms among Australian women using ALSWH data.

Chapter 6: The association between social support and antenatal depressive and anxiety symptoms among Australian women

This study examined the associations between social support and antenatal depressive and anxiety symptoms among Australian women. This chapter provides insights into the estimates of the associations between specific domains of social support and antenatal mental health problems among Australian women.

As indicated in the result below, a considerable proportion of pregnant Australian women had depressive and anxiety symptoms, which poses serious health concerns. Early screening of pregnant women for antenatal depressive and anxiety symptoms is important for the well-being of the mother and child. Low emotional/informational support and low affectionate support/positive social interaction have been identified as being significantly associated with antenatal depressive and anxiety symptoms, respectively. As such, it is recommended that targeted screening of pregnant women for social support is important to prevent anxiety and/or depressive symptoms among pregnant women. Policy-makers and those working on maternity care need to consider the development of community-based social support programs to maintain the mental well-being of pregnant women.

The results presented in this chapter have been published in the *BMC Pregnancy and Childbirth* Journal.

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Abstract

Background: Antenatal depression and antenatal anxiety adversely affect several obstetric and foetal outcomes and increase the rate of postnatal mental illness. Thus, to tackle these challenges, the need for social support during pregnancy is vital. However, an extensive literature search failed to show a published study on the relationship between domains of social support and antenatal depressive, as well as antenatal anxiety symptoms in Australia. This study examined the association between domains of social support and antenatal depressive and anxiety symptoms among Australian women.

Methods: The current study used data obtained from the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH), focusing upon women who reported being pregnant (n=493). Depression and anxiety were assessed using the 10 item Center for Epidemiological Studies Depression (CES-D-10) scale and the 9-item Goldberg Anxiety and Depression scale (GADS), respectively. The 19-item Medical Outcomes Study Social Support index (MOSS) was used to assess social support. A logistic regression model was used to examine the associations between domains of social support and antenatal depressive and anxiety symptoms after adjusting for potential confounders.

Result: The current study found 24.7% and 20.9% of pregnant women screened positive for depressive and anxiety symptoms, respectively. After adjusting for potential confounders, our study found that the odds of antenatal depressive symptoms was about five and threefold higher among pregnant women who reported low emotional/informational support (AOR=4.75; 95% CI: 1.45, 15.66; p=0.010) and low social support (overall support) (AOR: 3.26, 95%CI: 1.05, 10.10, p=0.040) respectively compared with their counterpart. In addition, the odds of antenatal anxiety symptoms was seven times higher among pregnant women who reported low affectionate support/positive social interaction (AOR=7.43; 95%CI: 1.75, 31.55; p=0.006).

Conclusion: A considerable proportion of pregnant Australian women had depressive symptoms and/or anxiety symptoms, which poses serious health concerns. Low emotional/informational support and low affectionate support/positive social interaction have a significant association with antenatal depressive and anxiety symptoms, respectively. As such, targeted screening of expectant women for social support is essential.

Keywords: Depressive symptoms, Anxiety symptoms, Social support, Emotional support, Affectionate support, Tangible support, women, Pregnancy.

Background

Pregnancy is a period that brings physiological and psychosocial changes in women, which increases the risk for the occurrence of mental illness (Smith et al., 2011; Wadhwa et al., 2002). Depression and anxiety are among the most common mental illness occurring during pregnancy (Dunkel Schetter, 2011; Rich-Edwards et al., 2006).

Depression is characterized by symptoms of depressed mood, or loss of interest, low self-esteem, feelings of worthlessness, loss of appetite, feelings of fatigue, and poor concentration (Kastrup & Ramos, 2007). A previous meta-analysis conducted in developed countries reported a 7.4%, 12.8% and 12% pooled prevalence of antenatal depression during the 1st, 2nd and 3rd trimester, respectively (Bennett et al., 2004). Also, a 25.3% pooled prevalence of antenatal depression was reported by a meta-analysis conducted in low and middle-income countries (LMICs) (Gelaye et al., 2016). An estimated prevalence of antenatal depression reported by studies conducted in Australian ranges, 6-6.2% (Buist et al., 2006; Ogbo et al., 2018), 7% (Eastwood et al., 2017) and 16.9% (Leigh & Milgrom, 2008).

Antenatal anxiety is defined as excess concerns about pregnancy, childbirth, the health of the infant and future parenting roles (Huizink et al., 2004). Based on a report of global level meta-analysis, the pooled prevalence of antenatal anxiety estimated a 34.4% pooled prevalence in LMICs and 19.4% in high-income countries (Dennis et al., 2017). Studies conducted in Australia revealed that the prevalence of antenatal anxiety ranges between 14–59% (Faisal-Cury & Menezes, 2007; Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Serçekuş & Okumuş, 2009; Teixeira et al., 2009).

The risk factors for antenatal anxiety include previous pregnancy loss (Bogaerts et al., 2013; Gong et al., 2013; Woods-Giscombé et al., 2010), stress (Bayrampour et al., 2015), abuse during pregnancy (Agrati et al., 2015; Bayrampour et al., 2015; Buist et al., 2011), history of mental illness (Bayrampour et al., 2015; Buist et al., 2011; Byatt et al., 2014; Fadzil et al., 2013), smoking/substance abuse (Arch, 2013; Bayrampour et al., 2015; Bogaerts et al., 2013; Rubertsson et al., 2014), drinking alcohol (Arch, 2013), antenatal depression, food insecurity, unplanned pregnancy (van Heyningen et al., 2017), low social support, and poor quality relationship with a partner (Biaggi et al., 2016). The risk factors for antenatal depression include anxiety, low social support, major life events, low income, history of abuse (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018), domestic violence (Edwards et al.,

2008), unplanned pregnancy, history of any mental illness, and stress (Biratu & Haile, 2015; Bisetegn et al., 2016).

Antenatal depression and anxiety adversely affect several obstetric and foetal outcomes and cause an increased rate of pregnancy complications and postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995). Untreated antenatal anxiety and depression may lead to postnatal depression for the mother, which may also result in an impaired interaction with her infant (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004). Thus, to tackle these challenges, the need for social support during pregnancy is vital (Da Costa et al., 2000).

Social support is defined as the provision of financial, instrumental, emotional, and psychological support for somebody by a social network of family members, friends, and community members (Cohen et al., 2004). It strengthens social relationships and promotes health and well-being for a successful pregnancy (Cohen et al., 2000). However, the relationship between the specific domains of social support and antenatal depression, as well as antenatal anxiety symptoms, remains understudied in Australia and globally. In addition, within the available evidence, there is a knowledge gap and reported inconsistencies regarding the association between specific domains of social support and mental health problems among pregnant women. Understanding the relationship between specific domains of social support and antenatal depression, as well as antenatal anxiety can assist in the process of establishing a specific type of community-based social support program to enhance the mental wellbeing of pregnant women.

Therefore, to address the abovementioned gaps in the current literature, this study examined the association between domains of social support and antenatal anxiety and depressive symptoms amongst Australian women.

Methods

Study design, population and sampling

The current study employed a community-based cross-sectional study design and reported per the guideline of the STROBE checklist (Additional file 6.1). This study analyses data from the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH) (Brown

et al., 1999; Loxton et al., 2018). ALSWH is a community-based longitudinal study focusing on the health and well-being of Australian women. Over 40,000 women were recruited to participate in 1996 (baseline) in three cohorts (1973–78, 1946–51 and 1921–26). Participants were selected randomly via the national health insurance database and completed mailed surveys every three years on average. From the 8,010 women who completed Survey 6 of the 1973–78 cohort in 2012, those who reported being pregnant (n=493) (age between 34-39 years) were included in the current analyses (Lee et al., 2005). Additional Information about the ALSWH can be found on the project website (www.alswh.org.au) and elsewhere (Loxton et al., 2018).

Outcome and Exposure variables

Antenatal depressive and anxiety symptoms were the outcome variables. The depressive symptom was assessed using the 10-item Center for Epidemiological Studies Depression (CES-D-10, possible range 0-30) scale. A cut-off point $\geq$ 10 out of 30 indicates the presence of depressive symptoms (Andresen et al., 1994). It has been used to examine depressive symptoms during pregnancy with good reliability (α=0.79) and validity (sensitivity: 97%; specificity: 84%) (Canady et al., 2009; Holzman et al., 2006; Marcus et al., 2003; Mosack & Shore, 2006; Seto et al., 2005). The anxiety symptoms were assessed using the anxiety subscale of the Goldberg Anxiety and Depression scale (GADS) (yes/no, a possible range of 0-9). GADS anxiety score of $\geq$ 6 indicates the presence of anxiety symptoms and has good reliability (α=0.77) (Goldberg et al., 1988) and validity (sensitivity: 83.1%, specificity: 81.8%). The GADS has been used with pregnant women in Australia (Leach et al., 2014).

The exposure variable for the current study was social support. The Medical Outcomes Study Social Support index (MOSS) was used to examine the functional support provided, with good reliability (α= 0.97) and validity (Russell & Smith, 2002; Sherbourne & Stewart, 1991) and used among Australian women (Chojenta et al., 2012). MOSS has an overall index of 19 items and four functional support subscales: emotional/informational support (8 items), tangible support (4 items), and affectionate/positive social interaction (7 items). Emotional/informational support is the expression of positive affect, being empathic, and providing advice or information which can provide a solution to a problem. Affectionate support/positive social interaction is the expression of love, affection and availability of others to share entertaining activities with an individual. Tangible/instrumental support is the provision of material or financial assistance. Each of the 19 items has a 5-point Likert response

(ranging from: 'none of the time'= 1 to 'all of the time'= 5) assessing the availability of support. Overall score and each domain of social support were categorized into high ("all of the time" and "most of the time") and low ("a little of the time/none" and "some of the time") social support (Sherbourne & Stewart, 1991).

Potential confounders and instruments used

Our study adjusted the potential confounders identified from previous studies and available in our dataset. The confounders were categorized into socio-demographic, behavioural and psychological, and obstetric factors. The socio-demographic confounders included; age, residence, marital status, highest educational qualification, and able to manage on available income (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018). Behavioural and psychological factors included; ever being in a violent relationship with a partner (yes/no) (Biaggi et al., 2016), substance use (current tobacco smoking, alcohol use, and ever used illicit drug) (Arch, 2013; Bayrampour et al., 2015; Bogaerts et al., 2013; Rubertsson et al., 2014), history of mental illness (history of depression in the past 3 years, and history of anxiety in the past three years) (Biratu & Haile, 2015; Bisetegn et al., 2016), stress (Bayrampour et al., 2015), and optimism. Finally, the obstetric confounding factors included; gestational age (months), GP use in the last 12 months, pre-term history (Biratu & Haile, 2015; Bisetegn et al., 2016), BMI (van Heyningen et al., 2017), and general health condition from their own perspective.

Study participants were requested to specify their marital status as either "married," "never married," "de facto," "separated," "divorced," or "widowed." For the current analysis, groups were re-categorized into either "partnered" (married or de facto) or "non-partnered" (single, divorced, separated, or widowed). Postcode of residence was used to categorise respondents as living in either "major cities of Australia", "inner regional Australia", "outer regional Australia", or "remote or very remote Australia".

Income stress was measured via how respondents reported their ability to manage on available income, with response options: "impossible", "difficult all of the time", "difficult some of the time", "not too bad", or "easy". For the purposes of analyses, these options were collapsed into two categories, "impossible or difficult all or some of the time" and "not too bad or easy".

The level of stress in the last 12 months among study participants was assessed using the Perceived Stress Questionnaire, which has been developed and validated for the ALSWH study (Bell & Lee, 2002). The tool examined the level of perceived stress in specific areas of life,

including study, relationships and own health. An overall mean stress score was determined, which ranges from 0 (no stress) to 4 (extreme stress). The Perceived Stress Questionnaire has good internal reliability (α=0.75) (Bell & Lee, 2003; Bell & Lee, 2006). Also, the Life-Orientation Test-Revised (LOT-R) was used to examine optimism (a scale of 0–24).

The consumption of alcohol among study participants was assessed using the National Health and Medical Research Council (NHMRC) guidelines and categorized as: low-risk drinker; non-drinker; rarely drinks; risky/ high-risk drinker (Site, 2008). Due to the small number of responses, the consumption of alcohol was then re-categorized as being either a "low-risk drinker" (non-drinker, low-risk drinker/rarely drinks) or a "high-risk drinker" (risky/high-risk drinker) of alcohol. Also, based on their response to a question asking their current status of cigarette smoking, participants were categorized as being either a "non-smoker" or a "current smoker" of cigarettes. Study participants were asked if they had used any of the following illicit drugs in the past 12 months; Marijuana; Amphetamines; LSD; Hallucinogens; Tranquillizers; Cocaine; Ecstasy/designer drugs; Inhalants; Heroin; Barbiturates; and Steroids. Based on their responses, the women were classified as being either a "non-user" or a "user" of an illicit drug.

Pregnancy body mass index (BMI) was assessed using self-reported weight during pregnancy (kg)/height (m) ^{2}, and classified according to the WHO's classification, underweight (<18.5 kg/m^2), normal weight (BMI 18.5-24.99 kg/m^2), overweight (BMI of 25–29.9 kg/m^2) and obese (BMI ≥30 kg/m^2) (Status, 1995).

Data analysis

Data were analysed using SPSS version 22. Chi-square tests and independent sample t-test analysis were performed to test for crude associations between the outcome variables (antenatal anxiety and depressive symptoms) and the confounding variables. Exposure variables include low emotional/instrumental support, low affectionate support/positive social interaction and low tangible support. The prevalence of antenatal anxiety and antenatal depressive symptoms was calculated for each of the independent variables.

During the bivariate analyses, variables with p ≤0.25 were entered into a multiple logistic regression model and adjusted for confounders. In the final model, the strength of association between the outcome variables and domains of social support was measured by adjusted odds ratios (AOR) with corresponding 95% confidence intervals. The significance level was set at

$p < 0.05$. The final model was assessed using the Hosmer and Lemeshow goodness of fit test (Hosmer & Lemeshow, 2000).

A sensitivity analysis was conducted to estimate the E-values to assess the effect of unmeasured confounding (Haneuse et al., 2019). The E-value is the minimum strength of association on the odds ratio estimate that an unmeasured confounder possibly will require to have with both the exposure and outcome to negate the reported associations based on measured confounders (Linden et al., 2020; VanderWeele & Ding, 2017).

Result

Demographic characteristics of participants

Table 6.1 describes the demographic characteristics of the study participants according to their risk of depression and anxiety as examined by the CESD-10 and GAD scales, respectively. The prevalence of antenatal depression and anxiety in the current study was 24.7% (95% CI: 21.2, 28.9), and 20.9% (95% CI: 17.5, 24.8), respectively. Also, 13.6% of pregnant women had comorbid depressive and anxiety symptoms. Of the total study participants, 11.8% and 6.5% had a history of depression and anxiety in the past three years, respectively.

The mean (±SD) age of the participants was 36.3 (standard deviation [SD] =1.42), and the majority of participants (95.1%) were married/De facto, while (65%) achieved a university degree. The majority of women (61.1%) lived in major cities, and 67.2% had a significant mean age difference between pregnant women with and without depressive symptoms, and it was higher among pregnant women with depressive symptoms ($p=0.029$). There was a significant relationship between the marital situation and depression status of participants; those with depressive symptoms were more likely to be non-partnered ($p< 0.016$).

Table 6.1: The association between sociodemographic characteristics of pregnant women and antenatal depression and anxiety (n= 493).

Demographic characteristics	Antenatal Depression				Antenatal Anxiety			
	No (n=365)	Yes (n=122)	Total (n=493)	p-value	No (n=390)	Yes (n=103)	Total (n=49)	p-value
	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	
Residence								
Major cities	220 (63.8)	64 (54.7)	284(61.4)	0.210	230 (62.3)	56(56.6)	286(61.1)	0.514
Inner regional	69 (20)	31 (26.5)	100(21.6)		80 (21.7)	23 (23.2)	103(22)	
Outer regional/remote/very remote	56 (16.2)	22 (18.8)	78(17)		59 (16)	20 (20.2)	79(16.9)	
Highest qualification								
University	246 (67.4)	71 (58.7)	317(63.9)	0.272	257 (66.2)	62 (60.2)	319(65)	0.517
Certificate/diploma or trade/apprenticeship	80 (21.9)	31 (25.6)	111(22.4)		85 (21.9)	27 (26.2)	112(22.8)	
School only	39 (10.7)	29 (15.7)	68(13.7)		46 (11.9)	14 (13.6)	60(12.2)	
Marital status								
Partnered	352 (96.4)	111 (91)	463(95)	0.016	370 (95.1)	98 (95.1)	468(95.1)	0.990
non-partnered	13 (3.6)	11 (9)	12(5)		19 (4.9)	5 (4.9)	24(4.9)	
Able to manage on income available								
Impossible/Difficult all of the time	18 (4.9)	25 (20.7)	43(8.8)	<0.001	23 (5.9)	20 (19.6)	43(8.8)	<0.001
Difficult some of the time	82 (22.5)	32 (26.4)	114(23.5)		89 (22.9)	29 (28.4)	118(24)	
Not too bad/It is easy	265 (72.6)	64 (52.9)	329(67.7)		277 (71.2)	53 (52)	330(67.2)	
	Mean (SD)	**Mean (SD)**		**p-value**	**Mean (SD)**	**Mean (SD)**		**p-value**
Age	35.78(1.39)	36.1 (1.45)	35.8(±1.40)	0.029	35.86 (1.42)	35.85 (1.39)	35.8(±1.4)	0.977

Behavioural, psychological and obstetric characteristics of participants

The behavioural, psychological, and obstetric characteristics of the study participants are presented in Table 6.2. The majority of the women (42.1%) were in the last trimester of their pregnancy, while 37.5% and 20.5% were in the second and first trimester, respectively. There was a significant association between women's use of GP in the last 12 months and antenatal depressive ($p=0.025$) and antenatal anxiety symptoms ($p<0.001$). From the total study participants, 38.4% of them reported $\geq$5 times General Practitioner (GP) use in the last 12 months. In terms of birth history, 14.3%, 7% and 4.7% of participants had Cesarean section (C/S), preterm and low birth weight history, respectively. Based on the WHO BMI classification, most pregnant women (54.4%) had normal weight, and 2.7% were underweight. Also, there was a significant association between BMI and antenatal depressive symptoms among study participants, and those with depressive symptoms were more likely to be obese ($p=0.034$).

The majority of participants (71.4%) reported excellent/very good general health conditions. Participants' general health condition status was significantly associated with their status of antenatal depressive ($p <0.001$) and antenatal anxiety symptoms ($p <0.001$). Participants with depressive as well as anxiety symptoms were more likely to have a fair/poor general health condition ($p <0.001$).

Of the total study participants, 11% ever had a violent relationship with a partner, and ever being in a violent relationship with a partner was significantly associated with antenatal anxiety ($p <0.001$) and antenatal depressive symptoms ($p <0.001$). Participants with depressive symptoms were more likely to have less optimism scores ($p <0.001$), and higher mean stress level ($p <0.001$). Likewise, those with anxiety symptoms were more likely to have a higher mean stress level ($p <0.001$) and less optimism score ($p <0.001$). Compared to non-depressed participants, a higher proportion of women with depressive symptoms reported current anxiety symptoms ($p <0.001$), a personal history of anxiety ($p <0.001$), and depression in the past three years ($p < 0.001$). Also, compared to non-anxious participants, a higher percentage of pregnant women with anxiety reported current depressive symptoms ($p <0.001$). Participants with current anxiety symptoms were more likely to have a personal history of depression ($p <0.001$) and antenatal anxiety ($p <0.001$) in the past three years.

Table 6.2: The association between behavioural, psychological and obstetric characteristics of pregnant women and antenatal depression and anxiety.

Variables	Antenatal Depression				Antenatal Anxiety			
	No (n=365)	Yes (n= 122)	Total (n=493)	p-value	No (n=390)	Yes (n=103)	Total (n=493)	p-value
Pregnancy months	**n (%)**	**n (%)**	**n (%)**		**n (%)**	**n (%)**	**n (%)**	
<3 month	74 (20.3)	25 (20.5)	99(20.3)	0.950	81 (20.8)	20 (19.4)	101(20.4)	0.746
3-6 month	140 (38.4)	45 (36.9)	185(38)		143 (36.7)	42 (40.8)	185(37.5)	
> 6 month	151 (41.4)	52 (42.6)	203(41.7)		166 (42.6)	42 (39.8)	208(42.1)	
GP use in the last 12 month								
1-2 times	108 (29.7)	22 (18)	130(26.7)	0.025	116 (29.8)	16 (15.5)	132(26.8)	<0.001
3-4 times	125 (34.3)	43 (35)	168(34.6)		137 (35.2)	32 (31.1)	169(34.3)	
≥5 times	131 (36)	57(46.7)	188(38.7)		136 (35)	55 (53.4)	191(38.9)	
History of C/S								
Yes	49 (13.5)	18 (14.9)	67(13.9)	0.710	55 (14.2)	15 (14.6)	70(14.3)	0.935
No	313 (86.5)	103 (21.3)	416(86.1)		331 (85.8)	88 (85.4)	419(85.7)	
Preterm history								
Yes	24 (6.7)	10 (8.3)	34(7)	0.553	30 (7.8)	4 (3.9)	34(7)	0.173
No	336 (93.3)	111 (91.7)	447(93)		355 (92.2)	98 (96.1)	453(93)	
Low birth weight history								
Yes	16 (4.4)	7 (5.7)	23(4.8)	0.558	19 (4.9)	4 (3.9)	23(4.7)	0.650
No	345 (95.6)	115 (94.3)	460(95.2)		367 (95.1)	99 (96.1)	466(95.3)	
Body Mass Index (BMI)								
Acceptable/Underweight(<25)	218 (60.7)	58 (47.5)	276(57.4)	0.034	224 (58.2)	54 (52.9)	278(57.1)	0.603

Overweight (25-30)	87 (24.2)	37 (30.3)	124(25.8)		98 (25.5)	28 (27.5)	126(25.9)	
Obese (>=30)	54 (15)	27 (22.1)	81(16.8)		63 (16.3)	20 (19.6)	83(17)	
General Health conditions from their own perspective								
Excellent/Very good	280 (76.7)	68 (55.7)	348(71.5)	<0.001	297 (76.2)	55 (53.4)	352(71.4)	<0.001
Good	76 (20.8)	46 (37.7)	122(25)		86 (22.1)	38 (36.9)	124(25.2)	
Fair/Poor	9 (2.5)	8 (6.6)	17(3.5)		7 (1.8)	10 (9.7)	17(34.4)	
Ever been in a violent relationship with a partner								
Yes	22 (6.1%)	30 (71.4)	52(11)	<0.001	29 (7.5)	23 (23)	52(10.9)	<0.001
No	337 (93.1)	85 (25.2)	422(89)		352 (91.2)	75 (75)	427(89.1)	
Current tobacco smoking								
Yes	13 (3.6)	9 (7.4)	22(4.5)	0.079	16 (4.1)	6 (5.8)	22(4.5)	0.450
No	352 (96.4)	113 (92.6)	465(95.5)		374 (95.9)	97 (94.2)	471(95.5)	
Alcohol use								
Low/High-risk drinker	261 (71.7)	79 (65.3)	340(70)	0.182	276 (71)	68 (66.7)	344(70)	0.400
Non-drinker	103 (28.3)	42 (34.7)	145(30)		113 (29)	34 (33.3)	147(30)	
Ever used illicit drugs								
Yes	228 (65.2)	88 (72.1)	316(65)	0.053	244 (62.6)	74 (71.8)	318(64.5)	0.081
No	137 (37.5)	34 (27.9)	171(35)		146 (37.4)	29 (28.2)	175(35.5)	
Current Anxiety (GAD)								
Yes (>6)	36 (9.9)	67 (54.9)	103(21.2)	<0.001	_	_		
No (<6)	328 (90.1)	55 (45.1)	383(78.8)		_	_		

Current Depression (CES-D 10)								
Yes (>8)	_	_			55(14.3)	67(65)	122(25)	<0.001
No (<8)	_	_			329(85.7)	36(35)	365(75)	
History of depression in the past 3 years (Previous Mental health)								
Yes	27 (7.5)	30 (25)	57(11.9)	<0.001	31 (8.1)	27 (26.5)	58(12)	<0.001
No	332 (92.5)	90 (75)	422(88.1)		352 (91.9)	75 (73.2)	427(88)	
History of anxiety in the past 3 years (Previous Mental health)								
Yes	14 (3.9)	18 (15)	32(6.7)	<0.001	19 (5)	13 (12.7)	58(12)	0.005
No	345 (96.1)	102 (85)	447(93.3)		364 (85)	89 (87.3)	427(88)	
Mean Stress score								
≤0.27	86 (23.6)	2 (1.7)	88(18.2)	<0.001	84 (21.6)	4 (3.9)	88(18)	<0.001
0.28-0.56	162 (44.5)	29 (24)	191(39.4)		174 (44.8)	21 (20.6)	195(39.8)	
0.57-0.82	68 (18.7)	31 (25.6)	99(20.4)		73 (18.8)	26 (25.5)	99(20.2)	
0.83-4	48 (13.2)	59 (48.8)	107(22)		57 (14.7)	51 (50)	108(22)	
Mean (±SD)	0.61(±0.43)							
LOT-R Optimism								
0-14.99	59 (16.2)	57 (47.1)	116(23.9)	<0.001	72 (18.5)	45 (43.7)	117(23.8)	<0.001
15-17.99	88 (24.1)	28 (23.1)	116(23.9)		96 (24.7)	23 (22.3)	119(24.2)	
18-18.99	81 (22.2)	20 (16.5)	101(20.8)		86 (22.1)	17 (16.5)	103(20.9)	
19-24	137(37.5)	16(13.7)	153(31.5)		135(34.7)	18(17.5)	153(31.1)	
Mean (±SD)	16.85(±4.05)							

Note: p-value was based on chi-square test and t-test statistics, Abbreviation: C/S: Cesarean Section

Associations between social support and depressive symptoms during pregnancy

The relationship between depressive symptoms and social support during pregnancy is presented in Table 6.3. After adjusting for potential confounders, the multiple logistic regression model found that the odds of antenatal depressive symptoms was fivefold higher among pregnant women who reported low emotional/informational support (AOR=4.75; 95% CI: 1.45, 15.66; p=0.010) compared with pregnant women who reported high emotional/informational support. Also, pregnant women who reported low social support (overall support) were three times more likely to be depressed (AOR: 3.26, 95% CI: 1.05, 10.10, p=0.040) compared with their counterparts.

Table 6.3: Multiple logistic regression model showing the association between social support and antenatal depressive symptoms among Australian Women after adjusting potential confounders (n= 493).

Variables	Antenatal Depression		AOR (95% CI)	p-value
	No (n=365)	Yes (n=122)		
	n (%)	n (%)		
Medical Outcomes Study Social Support Index				
Emotional/Informational support†				
High (All/Most of the time)	358 (98.1)	90 (73.8)	1	
Low (Some/none/little of the time)	7 (1.9)	32 (26.2)	4.75 (1.45, 15.66)	0.010
Affectionate/Positive social interaction†				
High (All/Most of the time)	361(98.9)	101(83.5)	1	
Low (Some/none/little of the time)	4(1.1)	20(16.5)	1.65 (0.38, 8.12)	0.53
Tangible Support†				
High (All/Most of the time)	341(93.4)	95(77.9)	1	
Low (Some/none/little of the time)	24(6.6)	27(22.1)	1.49 (0.53, 4.19)	0.44
Overall social support¥				
High (All/Most of the time)	356(97.5)	97(79.5)	1	
Low (Some/none/little of the time)	9(2.5)	25(20.5)	3.26 (1.05, 10.10)	0.040

†Model is adjusted for: marital status, age, GP use, BMI, general health condition from their own perspective, ever been in a violent relationship with a partner, ever used illicit drug, current Tobacco smoking, Alcohol use, current anxiety symptoms, history of depression in the past 3 years, history of anxiety in the past 3 years, mean stress score, and optimism. Hosmer and Lemeshow Test (Chi-square= 4.6, df= 8, p=0.799).

¥Model is adjusted for: marital status, age, GP use, BMI, general health condition from their own perspective, ever been in a violent relationship with a partner, ever used illicit drug, current Tobacco smoking, Alcohol use, current anxiety symptoms, history of depression in the past three years, history of anxiety in the past three years, mean stress score, and optimism. Hosmer and Lemeshow Test (Chi-square= 1.839, df= 8, p=0.986).

Associations between social support and anxiety symptoms during pregnancy

Table 6.4 shows the association between anxiety symptoms and low social support during pregnancy. After adjusting for potential confounders, the multiple logistic regression model found that the odds of antenatal anxiety symptoms was seven times higher among pregnant women who reported low affectionate support/positive social interaction (AOR=7.43; 95% CI: 1.75, 31.55; p=0.006) compared with pregnant women who reported high affectionate support/positive social interaction.

Table 6.4: Multiple logistic regression model showing the association between social support and antenatal anxiety symptoms among Australian women after adjusting potential confounders (n= 493).

Variables	Antenatal Anxiety			
	No (n=390)	Yes (n=103)	AOR (95% CI)	p-value
	n (%)	n (%)		
Medical Outcomes Study Social Support Index				
Emotional/Informational support†				
High (All/Most of the time)	374(96.1)	79(76.7)	1	
Low (Some/none/little of the time)	15(3.9)	24(23.3)	1.12 (0.36, 3.47)	0.840
Affectionate/Positive social interaction†				
High (All/Most of the time)	384 (98.7)	83 (81.4)	1	
Low (Some/none/little of the time)	5 (1.3)	19 (18.6)	7.43 (1.75, 31.55)	0.006
Tangible Support†				
High (All/Most of the time)	356(91.8)	83(80.6)	1	
Low (Some/none/little of the time)	32(8.2)	20(19.4)	0.88 (0.32, 2.45)	0.811
Overall social support¥				
High (All/Most of the time)	375(96.4)	82(79.6)	1	
Low (Some/none/little of the time)	14(3.6)	21(20.4)	2.55 (0.92, 7.06)	0.071

† Model is adjusted for: marital status, ability to manage available income, GP use, general health condition from their own perspective, ever been in a violent relationship with a partner, ever used illicit drug, preterm history, current depressive symptoms, history of depression in the past 3 years, history of anxiety in the past 3 years, mean stress score, and optimism. Hosmer and Lemeshow Test (Chi-square= 5.627, df= 8, p=0.689).

¥ Model is adjusted for: marital status, ability to manage on available income, GP use, general health condition from their own perspective, ever been in a violent relationship with a partner, ever used illicit drug, preterm history, current depressive symptoms, history of depression in the past 3 years, history of anxiety in the past 3 years, mean stress score, and optimism. Hosmer and Lemeshow Test (Chi-square= 5.238, df= 8, p=0.732).

Sensitivity analysis

We ran a sensitivity analysis to calculate the E-values to observe the effect of unmeasured confounders in the final adjusted model. It has been suggested that for measures of dichotomous outcomes, the respective E-values for point estimates and confidence interval can be obtained using the Odds ratio(OR) (outcome prevalence >15%) and its corresponding 95%CI in the online E-value formula (Linden et al., 2020; VanderWeele & Ding, 2017). Based on this assumption, statistical evidence from our E-values suggested that the odds ratio of the relationship between an unmeasured confounder and (i) low emotional support and antenatal depressive symptoms, (ii) low social support (overall support) and antenatal depressive symptoms and (iii) low affectionate support and antenatal anxiety symptoms would need to be at least 3.78, 3.01 (Additional file 6.2) and 4.89 (Additional file 6.3) respectively, for each association to negate the associations we found in the current study.

Discussion

This study revealed several important findings in relation to the prevalence rate of anxiety and depression, as well as the relationship between low social support and mental health problems, including depressive and anxiety symptoms, during pregnancy among Australian women.

After adjusting for potential confounders, in the current study, low emotional/informational support was found to have a significant association with higher odds of antenatal depressive symptoms. Likewise, the odds of depressive symptoms was three times higher among pregnant women who reported low social support (overall support) compared with their counterpart. Pregnant women with low emotional support/informational support may not have someone to confide in, obtain important information/advice from, or help reduce the negative emotions associated with a distressing situation, and as a result, they might be exposed to stress and may later develop depression (Thoits, 1986). The positive relationship between low social support (overall support) and antenatal depressive symptoms was supported by other studies conducted in Australia and internationally. A facility-based cross-sectional study conducted in Turkey among pregnant women (n=772) indicated that emotional and instrumental support from the mother-in-law and general support from the husband had an inverse relation with antenatal depression (Senturk et al., 2011). Also, a study conducted in Australia on pregnant women (n=367) emphasized that overall social support was negatively associated with antenatal depression (Leigh & Milgrom, 2008). Similarly, previous studies conducted in Ethiopia

(Dibaba et al., 2013), Sweden (Rubertsson et al., 2003), USA (Spoozak et al., 2009), Finland (Pajulo et al., 2001), and China (Tang et al., 2019) reported pregnant women who reported low social support were more likely to be depressed. However, none of the above-mentioned studies examined the relationship between specific domains of social support and antenatal depressive symptoms. On the contrary, a facility-based cross-sectional study conducted in Jordan (n=218) reported that social support during pregnancy has no association with antenatal depression (Abujilban et al., 2014). The possible reasons for this conflicting finding might be due to the variation in demographic characteristics of participants and tools used to assess social support and adjustment of confounders. In the study conducted in Jordan, participants were those with age $\geq$ 18 years and used the Duke Social Support and Stress Scale (DUSOCS) (12 items), which examines the amount of overall social support and the number of supportive people (Salameh, 2006). However, in our study, participants were between the age of 34-39 years old used the MOS-SSS (19 items) scale (Sherbourne & Stewart, 1991) to assess overall and domains of social support such as perceived emotional/informational support, tangible support, affectionate support, and positive social interaction.

Our study showed that pregnant women who reported low affectionate support/positive social interaction had higher odds of anxiety symptoms compared to pregnant women who reported high affectionate support/positive social interaction. Pregnant women with low affectionate support/positive social interaction are less satisfied with family and poor in interacting with the social environment, and as a result, they might be exposed to loneliness, become less in emotional and stress coping ability and later become more anxious (Alden & Mellings, 2004; Thoits, 1986). However, we found insufficient statistical evidence for an association between low social support (overall support) and antenatal anxiety symptoms. Similar findings were reported from facility-based studies conducted in Greece (n=165) (Gourounti et al., 2013) and Canada (n=5271) (Dunkel Schetter et al., 2016), which stated low social support had no significant association with antenatal anxiety. On the contrary, studies conducted in the US (Cheng et al., 2016), China (Gao et al., 2019; Tang et al., 2019), and Germany (Martini et al., 2015) all reported that low social support (overall support) had a significant association with antenatal anxiety symptoms. The possible reasons for this discrepancy might be due to the difference in demographic characteristics of participants, the instrument used to assess social support and the adjustment of potential confounders. For instance, the study conducted in the US (Cheng et al., 2016) used Turner Support Scale to assess only partner support given to pregnant women and adjusted only for confounders like maternal race/ethnicity, age, parity,

education, pre-pregnancy BMI, and household income. However, our study used MOS-SSS (19 items) scale (Sherbourne & Stewart, 1991) to assess the overall and specific domains of social support (i.e., emotional support/informational support, affectionate support/positive interaction and tangible support) and adjusted for potential confounders from socio-demographic, behavioural and psychological characteristics of participants.

Almost 1 in 4 pregnant women in our study met the screening criteria for depressive symptoms. The finding is supported by several other studies conducted worldwide, such as in Jamaica (25%) (Pottinger et al., 2009), Nigeria (24.9%) (Thompson & Ajayi, 2016), Brazil (24.3%) (Melo et al., 2012), Vietnam (22.4%) (Fisher et al., 2013) and South Africa (22%) (van Heyningen et al., 2016). However, our finding is higher than a previous Australian national report (6%) (Buist et al., 2006) and other studies conducted in Australia, ranging from 7% to 17% (Eastwood et al., 2017; Leigh & Milgrom, 2008). One possible reason for the inconsistency regarding the prevalence of depressive symptoms during pregnancy between the current study and other studies conducted in Australia might be the use of instruments used to examine depression. That is, all studies conducted in Australia used EPDS (10 items) with a total score of $\geq$13 considered a flag for possible depressive symptoms (Kaida et al., 2014), however, the current study used the CES-D-10 screening tool, with a score $\geq$ 10 suggestive of possible depressive symptoms (Andresen et al., 1994).

Our study found that 1 in 5 pregnant women screened positive for anxiety symptoms. A comparable estimate of antenatal anxiety symptoms was reported from a study conducted in Canada (23%) (Bayrampour et al., 2015) and a global level systematic review and meta-analysis, 18.2% (10 studies) for the 1st trimester and 19.1% (17 studies) for the 2nd trimester) (Dennis et al., 2017). However, a facility-based longitudinal cohort study conducted in Melbourne, Australia, reported a higher prevalence of antenatal anxiety (27.7%) (Leigh & Milgrom, 2008). The possible reason for the observed difference might be due to variations in the demographic characteristics of participants, participant recruitment method, and instrument employed to screen antenatal anxiety symptoms. For example, in the study conducted in Melbourne, Australia, participants were between the age of 17-45 years, recruited participants from antenatal clinic attendees, followed a longitudinal study design and used the Beck anxiety inventory scale (BAI-21 items) (a self-reported scale used to examine the level of physical and cognitive anxiety symptoms in the past week) (Beck et al., 1988) to screen antenatal anxiety, while in our study, participants were between the age of 34-39 years, recruited participants

from a community, and used GADS (a score $\geq$ 6 suggests the presence of anxiety symptoms) scale to screen antenatal anxiety symptoms.

Our study has some limitations that need to be considered when making inferences from our findings. First, the study relied on self-reported data from participants, which has the potential for recall bias to be introduced. Second, our findings are limited to pregnant women within the age range of 34-39 years, and as such, our findings may not be generalizable to younger pregnant women. Third, as the data analysis was cross-sectional, we cannot confirm the necessary time-based direction of events. Specifically, the presence of reverse causation between low social support and depressive and/or anxiety symptoms cannot be identified. Finally, the sample size of our study may have resulted in reduced statistical power and inflated effect size estimation. However, these limitations are countered by the fact that the study analyzed data collected from a nationally representative sample of pregnant women.

Conclusion

A considerable proportion of pregnant Australian women had depressive and anxiety symptoms, which poses serious health concerns. Early screening of pregnant women for antenatal depressive and anxiety symptoms is important for the well-being of the mother and child. Low emotional/informational support and low affectionate support/positive social interaction have been identified as being significantly associated with antenatal depressive and anxiety symptoms, respectively. As such, we recommend that targeted screening of pregnant women for social support is important to prevent anxiety and/or depressive symptoms amongst pregnant women. Policy-makers and those working on maternity care need to consider the development of community-based social support programs to maintain the mental well-being of pregnant women. Finally, for future researchers, we recommend longitudinal studies with the view to examine the causative relationship between low social support and depressive and/or anxiety symptoms during pregnancy.

Chapter Summary

This chapter provided the background, methodology and results for a study examining the association between social support and antenatal depression and anxiety among Australian pregnant women using ALSWH data. The study found that low emotional/informational support and low affectionate support/positive social interaction have been identified as being

significantly associated with antenatal depressive and anxiety symptoms, respectively. Also, this chapter discusses the current findings with the previous international literature. Finally, the implications, strengths, limitations and conclusion of the study were highlighted.

The following chapter will present a study assessing the association between marital status and antenatal mental disorders using NSW linked health administrative data.

Chapter 7: An examination of the association between marital status and antenatal mental disorders using linked health administrative data

This study examined the associations between marital status and antenatal mental disorders (depressive disorder, anxiety disorder and self-harm) using linked hospital data and perinatal data.

The study found that non-partnered pregnant women had a higher likelihood of depressive disorder, anxiety disorder, and self-harm than partnered women. As such, it is recommended that maternal healthcare professionals screen non-partnered pregnant women for antenatal mental health problems such as depression, anxiety and self-harm. Also, screening non-pregnant women for social support would be highly beneficial to assess the support level from other social networks. Policy-makers should consider developing targeted community-based social support programs to enhance pregnant women's mental well-being.

The results presented in this chapter have been published in the *BMC Pregnancy and Childbirth* journal.

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Abstract

Background: International research shows marital status impacts the mental health of pregnant women, with antenatal depression and anxiety being higher among non-partnered women. However, there have been few studies examining the relationship between marital status and antenatal mental disorders among Australian women.

Methods: This is a population-based retrospective cohort study using linked data from the New South Wales (NSW) Perinatal Data Collection (PDC) and Admitted Patients Data Collection (APDC). The cohort consists of a total of 598,599 pregnant women with 865,349 admissions. Identification of pregnant women for mental disorders was conducted using the 10th version International Classification of Diseases and Related Health Problems, Australian Modification (ICD-10-AM). A binary logistic regression model was used to estimate the relationship between marital status and antenatal mental disorder after adjusting for confounders.

Results: Of the included pregnant women, 241 (0.04%), 107 (0.02%) and 4359 (0.5%) were diagnosed with depressive disorder, anxiety disorder, and self-harm, respectively. Non-partnered pregnant women had a higher likelihood of depressive disorder (Adjusted Odds Ratio (AOR) =2.75; 95% CI: 2.04, 3.70) and anxiety disorder (AOR=3.16, 95% CI: 2.03, 4.91), compared with partnered women. Furthermore, the likelihood of experiencing self-harm was two times higher among non-partnered pregnant women (AOR=2.00; 95% CI: 1.82, 2.20) than partnered pregnant women.

Conclusions: Non-partnered marital status has a significant positive association with antenatal depressive disorder, anxiety disorder and self-harm. This suggests it would be highly beneficial for maternal healthcare professionals to screen non-partnered pregnant women for antenatal mental health problems such as depression, anxiety and self-harm.

Keywords: Depressive disorder, Anxiety disorder, Self-harm, Marital status, Pregnancy, Data linkage.

Background

Depression (Rich-Edwards et al., 2006), anxiety (Dunkel Schetter, 2011) and self-harm (Say et al., 2014) are among the most prevalent mental health problems during pregnancy. An international umbrella review indicated that the pooled prevalence of antenatal depression was 17% in high-income countries (Dadi, Miller, Bisetegn, et al., 2020), while studies conducted in Australia have reported a prevalence of depression ranging from 7-17% (Eastwood et al., 2017; Leigh & Milgrom, 2008). Also, various epidemiological studies have reported the prevalence of anxiety during pregnancy ranging from 14-59% (Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010a; Teixeira et al., 2009), while a study conducted in Australia have reported a 27% prevalence of antenatal anxiety (Leigh & Milgrom, 2008). These antenatal mental health problems adversely impact the mother's physical and emotional well-being (Kurki et al., 2000; Nicholson et al., 2006) as well as the well-being of infants and children (Hollins, 2007). The 2019 Australian health-economic analysis of the impact of depression and anxiety during the perinatal period estimated the costs at $877 million in the first year (PricewaterhouseCoopers, 2019). The 2020 Productivity Commission Mental Health Report also estimated the cost of improving perinatal mental health at an additional $18-23 million in direct expenditure (ProductivityCommission, 2020).

Antenatal depression and anxiety can result in adverse obstetric and foetal outcomes (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995; Steer et al., 1992; Stott, 1973), and impaired mother-infant interaction (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004; Murray et al., 1996). In addition, antenatal mental health problems have a significant association with substance use thereby potentially resulting in impaired quality of life (Dunkel Schetter, 2011; Shapiro et al., 2013; Straub et al., 2014). Based on reports from published studies, correlates of antenatal anxiety include pregnancy loss (Bogaerts et al., 2013; Gong et al., 2013; Woods-Giscombé et al., 2010), physical abuse (Agrati et al., 2015; Bayrampour et al., 2015; Buist et al., 2011), history of mental illness (Bayrampour et al., 2015; Buist et al., 2011; Byatt et al., 2014; Fadzil et al., 2013; Schmied et al., 2013), substance abuse (Arch, 2013; Bayrampour et al., 2015; Bogaerts et al., 2013; Rubertsson et al., 2014), unplanned pregnancy (van Heyningen et al., 2017), and low social support (Biaggi et al., 2016). Further, antenatal depression has a significant association with low social support, exposure to stressful events, low income, history of abuse (Edwards et al., 2008; Leigh & Milgrom, 2008; Ogbo et al., 2018),

unplanned pregnancy, and history of any mental illness (Biratu & Haile, 2015; Bisetegn et al., 2016).

Epidemiological studies show pregnant women with marital disruption or unmarried have a higher rate of developing antenatal depression (Fadzil et al., 2013; Gemta, 2015; Mossie et al., 2017) and anxiety (Fadzil et al., 2013) compared to partnered women. Also, a study conducted in Brazil demonstrated that the likelihood of antenatal suicide was significantly related to lack of a cohabiting partner (da Silva et al., 2012). Conversely, some studies conducted in Italy (Agostini et al., 2015), UK (Husain et al., 2012), and US (Luke et al., 2009) report a non-significant association between marital status and antenatal depression. Further, a study conducted in China reported a non-significant association between marital status and antenatal anxiety (QIAO et al., 2009).

Nonetheless, partnered pregnant women living in poor-quality relationships with their partners also appear to be at greater risk of antenatal mental health problems (Biaggi et al., 2016). Also, a study conducted in Victoria, Australia, found single mothers report higher levels of antenatal depressive symptoms than those with unsupportive partners (Bilszta et al., 2008). A review of longitudinal studies conducted in Australia and New Zealand indicated poor partner relationship as the strongest predictor of antenatal anxiety and depression (Schmied et al., 2013). Also, pregnant women in a violent relationship status receive less support from their spouses and even causes additional stress and anxiety, leading to adverse birth outcomes, including low birth weight and preterm birth (Bailey, 2010; Hamberger & Arnold, 1990).

The relationship between marital status and the risk of mental disorders, including depressive disorder, anxiety disorder and self-harm, has received little research attention in Australia and globally. There has also been a lack of studies utilising high quality linked data on this topic, which would create opportunities for more complex and expanded research. Also, it is vital to examine whether non-partnered status poses a particular disadvantage to pregnant women's mental health in terms of depressive disorder, anxiety disorder and self-harm risk. Understanding such relationships is important to inform approaches for supporting non-partnered pregnant women with a view to enhancing their mental wellbeing.

In direct response to these gaps in the current literature, our large cohort study aimed to assess the association between marital status and antenatal mental disorders among Australian women using linked health administrative data from the State of New South Wales (NSW), Australia.

We hypothesized that non-partnered marital status is significantly associated with antenatal depressive disorder, anxiety disorder and self-harm.

Methods

Data source and study population

The current population-based retrospective cohort study used linked data from the NSW Admitted Patients Data Collection (APDC) and the NSW Perinatal Data Collection (PDC) (https://www.cherel.org.au/data-dictionaries) and reported per the guideline of the STROBE checklist (Additional file 6.1). The APDC contains regularly collected data on inpatient services from all public and private hospitals and public multi-purpose service centres in NSW. APDC contains the demographic characteristics, clinical diagnosis and other clinical procedures of the patient. The PDC collects data on pregnancy and all births (i.e., hospital and homebirths) of $\geq$ 20 weeks gestation or birth weight of $\geq$ 400g.

Eligibility criteria and sample selection

The eligible criteria for inclusion in the current study were; first, women should be pregnant between 2000 and 2011 and reside in NSW. Second, there should be a report on their marital status. Hospital admissions for mental disorders were identified using data from the APDC dataset (2000-2011), which contains 646,233 mothers with 2,624,544 hospital admissions. In the PDC dataset (2000-2011), there were 649,210 mothers and 1,053,819 births. After excluding duplicate records, 609,299 mothers from the PDC dataset were linked with 882,238 admissions from APDC dataset. After excluding those women who have no data on marital status, 598,599 pregnant women with 865,349 admissions were included in the analyses. The details of the study population selection process and data linkage are presented in Figure 7.1.

The Centre for Health Record Linkage (CHeReL) executed the data linkage between the PDC and APDC datasets using probabilistic record linkage methods and Choice-maker software for these two data sources, which estimated a false positive rate of 0.3% and a false negative <0.5% of records.

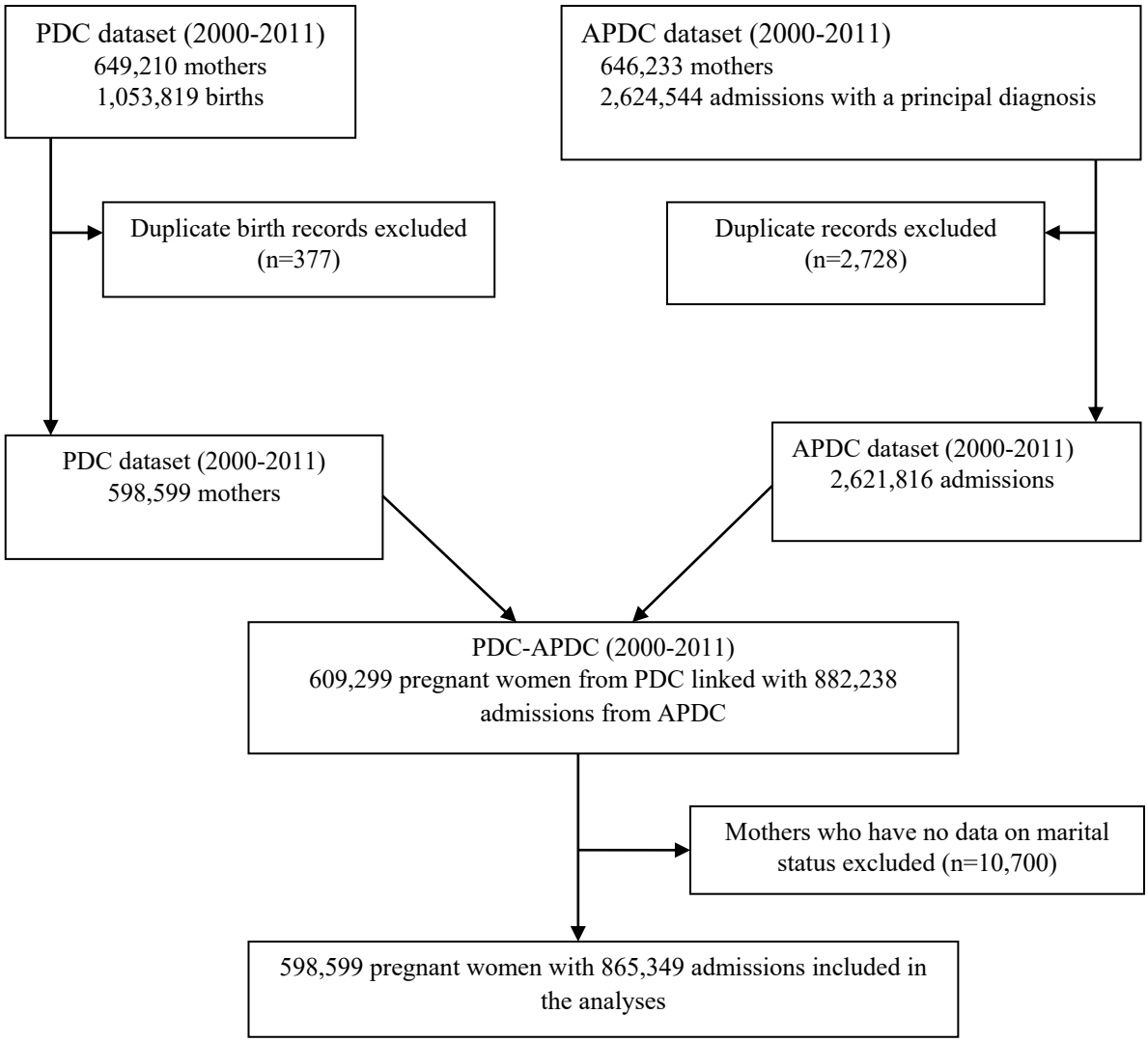

Figure 7.1: Study population and data linkage between PDC and APDC dataset.

Diagnoses of mental disorders

The diagnosis of mental health disorders of pregnant women was performed by a doctor at the inpatient department of hospitals in NSW and coded per the criteria of the 10th version International Classification of Diseases and Related Health Problems, Australian Modification (ICD-10-AM) (Innes et al., 1997). ICD-10-AM is a diagnostic mental health measure that likely picks up the more severe mental health disorder within the population and misses women with milder mental health disorders compared with screening or self-report measures. The record admission contains one principal diagnosis, one stay diagnosis and 53 other diagnoses (Health & Welfare, 2010). For the current study, only a principal diagnosis of depressive disorder, anxiety disorder or self-harm was considered for participant inclusion. The data for admission was taken from the Admitted Patients Data Collection (APDC) data set. A hospital

admission refers to any hospitalisation or admission of a patient to a hospital for inpatient service.

If a woman had the principal diagnosis of depressive episode [F32], recurrent depressive disorder [F33], persistent mood (affective) disorder [F34], other mood (affective) disorder [F38], or unspecified mood (affective) disorder [39], her admission was identified as depressive disorder. If a woman had the principal diagnosis of phobic anxiety disorders [F40], other anxiety disorders [F41], or obsessive-compulsive disorder [F42], her admission was identified as anxiety disorder. If a woman had the principal diagnosis of self-injuries and/or self-poisoning [S00-T75] or certain early complications of trauma [T79], her admission was identified as international self-harm.

Exposure and confounding variables

The exposure variable was marital status of pregnant women. The available response options on the marital status were never married, married/de facto relationship, separated, divorced, or widowed. Then, those with a marital status of never married, separated, divorced, and widowed were categorised as "non-partnered", whilst the remaining response (married and de facto relationship) were grouped as "partnered". The confounding variables included in the analyses were age, remoteness, socio-economic disadvantage, country of birth, indigenous status, and smoking status.

Statistical analysis

We undertook three steps to analyse the data. First, frequency and percentages were generated to show the prevalence of the outcome variables (depressive disorder, anxiety disorder and self-harm) among admitted pregnant were determined. Then, we cross-tabulated the distribution of the exposure variable (partnered or non-partnered) across the confounding and outcome variables, including using Pearson's chi-square test and Student's t-test to demonstrate statistically significant associations. Further, a binary logistic regression model was employed to determine the association between marital status and mental disorders (i.e. depressive disorder, anxiety disorder and self-harm) after adjusting for confounders. The results of the regression analyses in the final model were described using an adjusted odds ratio (AOR) with the respective 95% confidence intervals (CI). The final model was assessed using the Hosmer and Lemeshow goodness of fit test (Hosmer & Lemeshow, 2000). For all statistical analyses,

statistical significance was set at $p < 0.05$. Analyses was conducted using STATA/MP 16 (Stata Corp, USA).

Results

Among the 609,299 pregnant women who were living in NSW and their babies were firstborn between 2000 and 2011 by linking the APDC dataset and PDC dataset, 1.8% (n=10,700) did not report their marital status. Pregnant women with missing data on this exposure variable (i.e. marital status) were excluded from the analyses and thus data from 598,599 pregnant women were included in the analyses. A total of 241 pregnant women (0.04%) were with a principal diagnosis of depressive disorder, 107 (0.02%) with a principal diagnosis of anxiety disorder, and 4,359 (0.5%) with a principal diagnosis of intentional self-harm. None of the pregnant women were found to experience two or all of these mental health conditions.

The socio-demographic characteristics of study participants are presented in Table 7.1. The average age of the pregnant women was 29.6 (SD=5.8) years, with 31.8% (n=193,439) of the women were between the age of 30-34 years and 28.1% (n=171, 373) were aged 25-29 years. The majority of the pregnant women (67.4%) resided in a major city.

Table 7.1 also provides a comparison between partnered and non-partnered pregnant women by demographic and health-related characteristics. In comparison to non-partnered women, partnered women were more likely to: be older; reside in a major city; have a lower level of socio-economic disadvantage; be a non-smoker; be born outside of Australia; be non-Indigenous; and/or have full health insurance cover (all $p<0.001$). In addition, partnered women, in comparison to non-partnered women were more likely to: have gestational diabetes; have gestational hypertension; not have preeclampsia; not have a depressive disorder; not have anxiety, and/or not self-harm (all $p<0.001$).

Table 7.1: Characteristics of study participants stratified by marital status.

Factors	Marital status			
	Non-partnered (n=112,443 women)	Partnered (n=486,156 women)	Total (598,599 women)	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**p-value[A]**
Age (mean±SD)	26.0±6.6	30.4±5.2	29.6±5.8	<0.001
	n (%)	**n (%)**	**n (%)**	**p-value[B]**
Remoteness				
Major cities	63,309 (57.2)	335,633 (69.8)	398,942 (67.44)	<0.001
Inner regional	33,119 (29.9)	107,812 (22.4)	140,931 (23.83)	
Out regional and remote	14,321 (12.9)	37,328 (7.8)	51,649 (8.73)	
Socio-economic disadvantage				
1st quintile (least disadvantaged)	12,112 (10.9)	110,531 (23.0)	122,643 (20.73)	<0.001
2nd quintile	17,515 (15.8)	100,915 (21.0)	118,430 (20.02)	
3rd quintile	21,867 (19.7)	89,191 (18.6)	111,058 (18.77)	
4th quintile	27,937 (25.2)	82,829 (17.2)	110,766 (18.73)	
5th quintile (most disadvantaged)	31,318 (28.3)	97,307 (20.2)	128,625 (21.74)	
Smoking status				
No	68,158 (65.5)	407,654 (91.3)	475,812 (86.45)	<0.001
Yes	35,839 (34.5)	38,766 (8.7)	74,605 (18.38)	
Country of birth				
Australia	92,340 (82.1)	313,478 (64.5)	405,818 (67.79)	<0.001
Other countries	20,103 (17.9)	172,678 (35.5)	192,781 (33.21)	
Indigenous status				
No	103,010 (92.3)	477,410 (98.9)	580,420 (97.67)	<0.001
Yes	8,632 (7.7)	5,212 (1.1)	13,844 (4.54)	
Health insurance status				
No cover	77,104 (88.4)	228,032 (56.6)	305,136 (62.26)	<0.001
Basic cover	3,352 (3.8)	44,845 (11.1)	48,197 (9.83)	

Full cover	6,542 (7.5)	128,679 (31.9)	135,221 (27.59)	
Ancillary cover only	199 (0.2)	1,346 (0.3)	1,545 (0.32)	
Depressive disorders				
No/not stated	112,336 (99.9)	486,022 (99.9)	598,358 (99.96)	<0.001
Yes	107 (0.1)	134 (0.03)	241 (0.04)	
Anxiety disorder				
No/not stated	112,400 (99.9)	486,092 (99.9)	598,492 (99.98)	<0.001
Yes	43 (0.04)	64 (0.01)	107 (0.02)	
Presence of self-harm				
No/not stated	173,431 (99)	687,559 (99.6)	860,990 (99.50)	<0.001
Yes	1,770 (1.0)	2,589 (0.4)	4,359 (0.50)	
Gestational diabetes				
No/not stated	108,448 (96.5)	460,132 (94.7)	568,580 (94.99)	<0.001
Yes	3,995 (3.6)	26,024 (5.4)	30,019 (5.01)	
Gestational hypertension				
No/not stated	45,501 (96.2)	206,355 (95.0)	251,856 (95.18)	<0.001
Yes	1,803 (3.8)	10,952 (5.0)	12,755 (4.82)	
Pre-eclampsia				
No/not stated	45,986 (97.2)	211,944 (97.5)	257,930 (97.48)	<0.001
Yes	1,318 (2.8)	5,363 (2.5)	6,681 (2.52)	

[A] p-value was obtained from Student's t-tests
[B] p-value was obtained from a chi-square test

Table 7.2 shows the association between marital status and mental disorders after adjusting for the available confounders. The multiple logistic regression model estimated that the odds of depressive disorder was 2.75 times higher among the non-partnered pregnant women compared with the partnered women (AOR=2.75; 95%CI: 2.04, 3.70; p<0.001). In addition, the odds of anxiety disorder during pregnancy was 3.16 times higher among non-partnered women (AOR: 3.16, 95%CI: 2.03, 4.91; p<0.001). Furthermore, the model estimated that the odds of experiencing self-harm was two times higher among non-partnered pregnant women compared to their counterpart (AOR=2.0; 95%CI: 1.82, 2.20; p<0.001).

Table 7.2: Association between marital status and mental disorders among admitted pregnant women in NSW, 2000-2011.

Factor	Depressive disorder		Anxiety disorder		Self-harm	
	Model I	**Model II**	**Model I**	**Model II**	**Model I**	**Model II‡**
	OR (95% C.I.)	AOR (95% C.I.)	OR (95% C.I.)	AOR (95% C.I.)	OR (95% C.I.)	AOR (95% C.I.)
Marital status						
Partnered	1.00	1.00	1.00	1.00	1.00	1.00
Non-partnered	3.45 (2.68-4.45)	2.75 (2.04-3.70)*	2.91 (1.97-4.28)	3.16 (2.03-4.91)*	2.77 (2.56-3.00)	2.00 (1.82-2.20)*

Model I: Unadjusted model.

Model II: Adjusted for sociodemographic factors (age, remoteness, socioeconomic disadvantage, country of birth and Indigenous status) and smoking status.

Model II‡: Adjusted for sociodemographic factors (age, remoteness, socioeconomic disadvantage, country of birth and Indigenous status), smoking status, anxiety disorder and depressive disorder.

Abbreviation: AOR: Adjusted Odds Ratio, C.I: Confidence Interval.

* $p<0.001$.

Hosmer and Lemeshow goodness-of-fit: for depressive disorder: $\chi2 = 8.37$; $p=0.398$, for anxiety disorder: $\chi2 = 4.73$; $p=0.786$; for self-harm: $\chi2 = 8.99$; $p=0.343$.

Discussion

This study identified several important findings regarding the relationship between marital status and antenatal mental disorders among admitted Australian women. In particular, non-partnered pregnant women were more likely to suffer from a depressive disorder, anxiety disorder or self-harm than partnered pregnant women.

Our study found that antenatal depressive disorder is more likely among non-partnered pregnant women than their partnered counterparts. Various international epidemiological studies also found that non-partnered pregnant women (not married, single or not living together with a partner) have higher odds of suffering from depressive symptoms during the antenatal period compared to partnered women (Adewuya et al., 2007; Brittain et al., 2015; Fadzil et al., 2013; Faisal-Cury & Menezes, 2007; Gemta, 2015; Mossie et al., 2017; Weobong et al., 2014). Furthermore, our study adds further evidence to the findings of previous research conducted in Victoria, Australia (n=1578) (Bilszta et al., 2008), which found single mothers report higher levels of antenatal depressive symptoms compared to women with supportive partners. Interestingly, the authors also found that single pregnant women reported lower levels of depressive symptoms than those with unsupportive partners (Bilszta et al., 2008). Some studies report a non-significant association between marital status and antenatal depression (Agostini et al., 2015; Glazier et al., 2009; Husain et al., 2012; Luke et al., 2009). The difference between the current and previous studies might be due to the variation in adjusting potential confounders and study participants' demographic characteristics. For example, a study conducted in UK adjusted for confounders such as marital satisfaction, previous history of mental illness and social support (Husain et al., 2012), and a study conducted in Italy also adjusted for confounders such as social support, stressful life events and relationship problem with a partner (Agostini et al., 2015). Furthermore, of the total participants (n=546) of a study conducted in the US, most were single (91%, n=497) (Luke et al., 2009), which can limit the statistical power of analysis and result in a non-significant association.

Our study demonstrated that the likelihood of antenatal anxiety disorder was three-fold higher among non-partnered women. Similarly, other studies conducted in Malaysia, Mexico, and Brazil have also shown that non-partnered pregnant women have a higher level of anxiety during the antenatal period (Fadzil et al., 2013; Faisal-Cury & Menezes, 2007; Salgado et al., 2019) compared to partnered women. Conversely, a facility-based study conducted in China

Shanghai (n=527) (QIAO et al., 2009) reported a non-significant association between marital status and antenatal anxiety. The possible reason for the non-significant association could be that most of the study participants were married (98.6%, n=520) (QIAO et al., 2009), which can limit the statistical power of the analyses.

Our study also found that the likelihood of experiencing self-harm was two times higher among non-partnered pregnant women compared to those with partnered marital status. Support for the finding in the current study comes from cross-sectional studies conducted in Brazil (n=1414) (da Silva et al., 2012) and Ethiopia (n=423) (Anbesaw et al., 2021), focusing on pregnant women attending the antenatal care unit demonstrated that the likelihood of suicide was significantly related to lack of a cohabiting partner. A study conducted in Brazil (da Silva et al., 2012) also performed a separate regression analysis for depressed pregnant women and found the odds of suicide was higher among non-partnered (single, divorced or widowed) depressed pregnant women (n=315) (da Silva et al., 2012). Studies conducted in South Africa (n=649) (Redinger et al., 2021), Australia (n=1507) (Giallo et al., 2018) and US (n=383) (Newport et al., 2007) reported a non-significant association between marital status and self-harm during pregnancy. The null result in a study conducted in South Africa could be due to adjusting for important confounders such as social support, marital stress, relationship with a partner, and previous history of mental illness, which was not possible in the current study (Redinger et al., 2021). Also, the study conducted in Australia which examined predictors of persistent self-harm (thought/attempt) adjusted for confounders such as intimate partner violence and afraid of partner during multivariate logistic regression analysis (Giallo et al., 2018). In a study conducted in US, Only 1 of the study participants attempted suicide during pregnancy, which might be due to the active participation of all study subjects in mental health treatment and willingly participated in the study, which might help in early identification and intervention of suicidal ideation (Newport et al., 2007). Thus, the observed association in the current study could be due to inadequate adjustment of confounders. Further studies confirming this finding are recommended.

Almost 1 in 2500 pregnant women in the current study met the ICD-10-AM diagnostic criteria for depressive disorder. The prevalence in the present study is lower than the pooled prevalence of antenatal depression in high-income countries (17%) (Dadi, Miller, Bisetegn, et al., 2020), as well as the reported prevalence of other studies conducted in Australia 7-17% (Eastwood et al., 2017; Leigh & Milgrom, 2008). The discrepancy in the prevalence of antenatal depression

might be due to the use of instruments to examine depression. For example, studies conducted in Australia used 10 item EPDS (10 items) with a score of ≥ 13, suggesting depressive symptoms, which are highly sensitive and inflate positive depression cases (Thombs et al., 2018), whereas in the current study, depressed women were identified using a diagnostic tool (ICD-10-AM).

Our study also found that 1 in 5000 pregnant women diagnosed with anxiety disorder. A higher estimate of antenatal anxiety was reported from a study conducted in Australia (27%) (Leigh & Milgrom, 2008) and other epidemiological studies (14-59%) (Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010a; Teixeira et al., 2009). The possible reason for the discrepancy could be that the study conducted in Australia used Beck Anxiety Inventory (BAI) (i.e., a score of ≥ 16) to screen anxiety symptoms, possibly inflating probable anxiety. In contrast, our study employed ICD-10 AM to diagnose a antenatal anxiety disorder.

Around 1 in 200 pregnant women in the current study diagnosed with intentional self-harm, which is lower than a report of an international review (5-14%) (Lindahl et al., 2005) and a study conducted in Australia (n=1507) (5%) (Giallo et al., 2018) and South Africa (n=649) (18%) (Redinger et al., 2021). The discrepancy might be due to the fact that studies conducted in South Africa and Australia examined self-harm (thought/attempt) using a single-item screening tool from the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987), which is more likely to inflate antenatal self-harm compared to ICD-10 AM.

Marital status (Fadzil et al., 2013; Gemta, 2015; Mossie et al., 2017) and the quality and length of the marriage relationship significantly affect antenatal mental health problems and the level of antenatal social support (Biaggi et al., 2016). For pregnant women, a marital partner is one of the key sources of emotional and tangible support (Eaton, 1978). For many pregnant women, their marital partner plays a vital role in detecting perinatal depressive and anxiety symptoms and supports in seeking healthcare professional help (Atkinson et al., 2021; Fonseca & Canavarro, 2017). Also, partner support and marital stability are important protective factors for the psychological well-being of pregnant women (Freitas & Botega, 2002). Furthermore, partnered women have enormous psychosocial advantages compared to non-partnered women, though much of this may be restricted to women living in a quality marital relationship (Kaplan & DeLongis, 1983). Despite the continued debate about the definition, the available evidence in developed countries viewed the quality of marital relationship as a multidimensional concept that measures objective features of marital relationship such as friendship, communication,

affection, and trust, along with subjective features like marital satisfaction (Glenn, 1990). Studies have also shown that non-partnered pregnant women have a higher risk of antenatal depression and anxiety than women with a supportive partner (Figueiredo et al., 2006; Wahn & Nissen, 2008). Also, an Australian population-based panel study found a decline in mental health for women who were separated or widowed (Hewitt et al., 2012). Interestingly, partnered pregnant women living in poor-quality relationships with their spouses also appear at greater risk of antenatal anxiety and depression (Biaggi et al., 2016; Gourounti et al., 2014; Nasreen et al., 2011) because they are exposed to additional stress and anxiety from their spouses (Hamberger & Arnold, 1990). Besides, stress due to a challenging marital relationship with the spouse makes an adjustment to the current pregnancy difficult for the woman (Marchesi et al., 2009), subsequently leading to antenatal and postnatal mental health problems and adverse birth outcomes (Bailey, 2010). A review of longitudinal studies examining maternal mental health in Australia and New Zealand indicated poor partner relationship as the strongest predictor of antenatal anxiety and depression (Schmied et al., 2013). Also, a study conducted in Canada (n=3021) indicated that poor quality of marital relationships and partner tension significantly predicts antenatal anxiety (Bayrampour et al., 2015). Evidence has also shown that lack of support from a partner coupled with barriers to health education correlates with decreased antenatal stress coping for low-income women (Parrott, 2021). Even though no study has yet examined the relationship between the mental well-being of the spouse and antenatal mental health problems, it could be a possible risk factor for antenatal mental health problems. Nonetheless, the psychopathology of the spouse played a significant positive role in the postnatal period for the occurrence of maternal depression (Paulson & Bazemore, 2010).

Strength and limitation

Our study has a number of important strengths. Our results are based on large population-based administrative data linked from PDC and OPDC sources. Also, it is the first study assessing the relationship between marital status and antenatal mental health problems (depressive disorder, anxiety disorder and self-harm) using high-quality linked data.

However, our study also has limitations. Since we did not have data on the following variables, our study did not adjust for the confounding role of social support, pre-pregnancy mental health problems, partner mental health status, intimate partner violence, length and quality of the marital relationship, which can play a key role in the observed associations. Evidence indicated the possible over-enumeration of admission due to depressive disorder, anxiety disorder, and

self-harm might be because admissions could happen due to medical problems related to the perinatal period (Jones et al., 2008; Matthey & Ross-Hamid, 2011). During analysis, the overestimation of mental disorders was managed by including only admissions with a principal diagnosis of mental disorder. Lastly, more recent data should be examined to see if the associations identified in our analyses still hold.

Conclusion

The partner status of Australian pregnant women has a significant positive association with antenatal depressive disorder, anxiety disorder and self-harm. This suggests it would be highly beneficial for maternal healthcare professionals to screen non-partnered pregnant women for antenatal mental health problems such as depression, anxiety and self-harm. Also, screening non-pregnant women for social support is vital to assess the support level from other social networks. Policy-makers need to consider developing targeted community-based social support programs to enhance pregnant women's mental wellbeing.

Chapter Summary

This chapter provided the background, methodology and results for a study examining the relationship between marital status and antenatal mental disorders among admitted Australian pregnant women using NSW-linked data. Also, the discussion of the study findings with the previous literature was displayed. Finally, the implications, study limitations and conclusion of the finding were presented.

The following chapter will present a study assessing the mediational role of social support in the relationship between perceived stress and antenatal depressive and anxiety symptoms among Australian women.

Chapter 8: The mediational role of social support in the relationship between stress and antenatal depressive and anxiety symptoms among Australian women

This study was undertaken with the aim of examining the mediational role of social support in the relationship between perceived stress and antenatal depressive and anxiety symptoms among Australian women. Therefore, this chapter provides insights into the stress-buffering role of overall and specific domains of social support amongst Australian pregnant women.

As indicated in the result below, the study found that emotional/informational support has a partial mediating effect on the relationship between stress and antenatal depressive symptoms and on the relationship between stress and antenatal anxiety symptoms. Affectionate support/positive social interaction and tangible support were found to play no significant mediation role between stress and antenatal depressive and anxiety symptoms. Therefore, in order to protect pregnant women from the effect of stress, maternal health professionals are advised to develop community-based social support programs and encourage the social network of pregnant women to improve the social support being given.

The results presented in this chapter have been published in the *Reproductive Health* Journal:

> Bedaso, A., Adams, J., Peng, W., & Sibbritt, D. (2021). The mediational role of social support in the relationship between stress and antenatal anxiety and depressive symptoms among Australian women: a mediational analysis. *Reproductive Health*, *18*(1), 1-10. https://doi.org/10.1186/s12978-021-01305-6.

Abstract

Background: Pregnancy can be a stressful period for most women and their family members, and the mental wellbeing of pregnant women can face serious challenges. Social support can play a role in improving the psychological well-being of pregnant women by enhancing stress coping ability and alleviating stressful conditions. The current study aimed to assess the mediating effects of social support in the relationship between perceived stress and depressive symptoms as well as anxiety symptoms during pregnancy among Australian women.

Methods: Of the 8,010 women who completed Survey 6 of the 1973–78 Australian Longitudinal Study on Women's Health (ALSWH) cohort in 2012, those who reported being pregnant (n=493) were included in the current analyses. Antenatal depressive and anxiety symptoms were assessed using the 10 item Center for Epidemiological Studies Depression (CES-D-10) scale and the 9-item Goldberg Anxiety and Depression scale (GADS), respectively. The 19 item Medical Outcomes Study Social Support index (MOSS) was used to examine social support. A parallel mediation model was used to explore the mediational role of each domain of social support between perceived stress and antenatal depressive and anxiety symptoms.

Result: The study found that emotional/informational support has a partial mediating effect on the relationship between perceived stress and antenatal depressive symptoms (β=0.371, 95%CI: 0.067, 0.799) and on the relationship between perceived stress and antenatal anxiety symptoms (β=0.217, 95%CI: 0.029, 0.462). Affectionate support/positive social interaction and tangible support was found to play no significant mediation role between stress and antenatal depressive and anxiety symptoms.

Conclusions: Emotional/informational support appears to play a mediating role in the relationship between stress and antenatal depressive, as well as between stress and antenatal anxiety symptoms. In order to further protect pregnant women from the effects of stress, policymakers and maternal health professionals are advised to develop community-based social support programs to enhance antenatal psychosocial support and ensure pregnant women have adequate emotional/information support.

Keywords: Stress, depressive symptoms, anxiety symptoms, social support, pregnancy, Mediation

Background

Pregnancy is accompanied by changes to a woman's body hormones, physical appearance, lifestyle, roles and responsibilities (Guardino & Dunkel Schetter, 2014; Razurel et al., 2013). Such changes can cause stress in pregnant women (Cardwell, 2013) and lead to an increased risk of developing mental health problems such as depressive symptoms (Razurel et al., 2013), and anxiety symptoms (Roos et al., 2013).

Depression and anxiety are among the most prevalent mental health problems experienced by pregnant women (Dunkel Schetter, 2011; Rich-Edwards et al., 2006). An estimated prevalence of antenatal depression reported by studies conducted in Australia ranges from 6-7% (Buist et al., 2006; Ogbo et al., 2018) to 16.9% (Leigh & Milgrom, 2008), while the prevalence of antenatal anxiety in Australia ranges from 14–59% (Faisal-Cury & Menezes, 2007; Hernández-Martínez et al., 2011; Nieminen et al., 2009; Rico et al., 2010b; Serçekuş & Okumuş, 2009; Teixeira et al., 2009). Depression and anxiety during pregnancy adversely affect several obstetric and foetal outcomes and cause an increased rate of pregnancy complications and postnatal mental health problems (Freeman, 2008; Hollins, 2007; Kurki et al., 2000; Orr & Miller, 1995). Untreated antenatal anxiety and depression may lead to postnatal depression for the mother which may also result in an impaired interaction with her infant (Figueiredo et al., 2009; Hart et al., 1998; Heron et al., 2004).

Social support is a resource or means an individual can use to cope with stressful events and improve psychological wellbeing (Gottlieb & Bergen, 2010). It is defined as the provision of emotional, informational, affectionate, and tangible (i.e. financial or instrumental) support for somebody by the available social network (i.e. family members, friends, and/or community members) (Cohen et al., 2004). Social support can strengthen social relationships and promotes health and well-being for a successful pregnancy (Cohen et al., 2000).

Different hypotheses have suggested several mechanisms of action of social support in preventing antenatal mental health problems. First, social support plays a stress-buffering role which directly contributes to the well-being of individuals by enhancing positive affect and/or perceived self-worth of individuals and indirectly improves well-being by alleviating stressful conditions (Cohen & Wills, 1985). Second, per the psycho-neuroimmunology (PNI) framework (McnCain et al., 2005), social support can change negative responses related to stress, which help individuals to improve their problem-solving skill and develop a positive

view about themselves (Ngai & Chan, 2012; Xia et al., 2013). Third, the behavioural mechanism approach also considered social support as the support needed during a stressful event to enhance the stress coping ability, which in turn reduces the risk of mental illness (Wills & Ainette, 2012). The psychosocial stress hypothesis suggested social support as a preventive factor to reduce the risk of antenatal depression (Jeong et al., 2013) and anxiety (Aktan, 2012) and depressive symptoms in the general population (Gariepy et al., 2016; Santini et al., 2015; Wang et al., 2018).

The stress-buffering hypothesis supports the mediating role of social support in the linkage between stress and antenatal depressive and antenatal anxiety symptoms, which hypothesizes that social support can protect people facing stress from developing mental health problems, such as depression and anxiety (Gottlieb & Bergen, 2010). This mediating effect may change an individual's perceptions about undesirable events and provide solutions by encouraging changes in an individual's adaptive responses (Razurel et al., 2011) and assist people in getting the skills required to buffer the effects of stressors (Kingston et al., 2012); subsequently, the occurrence of adverse consequences will be less likely (Andreotti et al., 2013).

Although few studies have identified that overall social support has a mediating effect on the linkage between stress and risk of developing mental illness during pregnancy (Lau & Wong, 2008; Pires et al., 2014), the linkage between specific domains of social support (emotional/informational support, affectionate support and tangible support) and depressive and anxiety symptoms during pregnancy needs further investigation among pregnant women. In response, the study reported here aimed to directly fill this knowledge gap by examining the mediating role of emotional/informational support, affectionate support/positive social interaction and tangible support in the linkage between stress and depressive and anxiety symptoms among pregnant Australian Women using nationally representative secondary data from the 1973-78 ALSWH cohort.

Method

Study design and data source

This study used data from the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH) (Brown et al., 1999; Loxton et al., 2018). The ALSWH is an ongoing nationally representative community-based longitudinal study focusing on the health and well-being of Australian women. Over 40,000 women were recruited to participate in 1996

(baseline) in three age cohorts (birth year: 1973–78, 1946–51 and 1921–26). Participants were selected randomly via the national health insurance database (Medicare) and asked to complete mailed surveys every 3 years on average. Of the 8,010 women who completed Survey 6 of the 1973–78 cohort in 2012 (age between 34-39 years), those who reported being pregnant (n=493) were included in the current analyses (Lee et al., 2005).

Measurement

Depression was assessed using the 10-item Center for Epidemiological Studies Depression (CES-D-10) scale and has good reliability (α=0.79) (Andresen et al., 1994). Items were summed to form a total score ranging from 0 to 30, with higher scores indicating a greater level of depressive symptoms. The CES-D-10 has been used to examine depressive symptoms during pregnancy with good reliability and validity (Canady et al., 2009; Holzman et al., 2006; Marcus et al., 2003; Mosack & Shore, 2006; Seto et al., 2005). Anxiety symptoms were assessed using the 9-item anxiety subscale of the Goldberg Anxiety and Depression scale (GADS). Items were summed to form a total score ranging from 0 to 9, with higher scores indicating a greater level of anxiety symptoms. The scale has good reliability (α=0.77) (Goldberg et al., 1988).

The Medical Outcomes Study Social Support index (MOS-SSS-19) was used to examine social support given to pregnant women. The MOS-SSS-19 has an overall index of 19 items (Cronbach's alpha 0.81), with higher scores indicating greater social support. The MOS-SSS-19 has three functional support subscales: emotional/informational support, tangible support, affectionate support/positive social interaction (Sherbourne & Stewart, 1991). The level of stress in the last 12 months among study participants was assessed using the Perceived Stress Questionnaire, which has been developed and validated for the ALSWH study (Bell & Lee, 2002). The tool examined the level of perceived stress in specific areas of life, including study, relationships and own health. An overall mean stress score was determined, which ranges from 0 (no stress) to 4 (extreme stress). The Perceived Stress Questionnaire has good internal reliability (α=0.75) (Bell & Lee, 2003; Bell & Lee, 2006).

Mediation model

This study used the stress-buffering hypothesis (Cohen & Wills, 1985) to explore the mediational role of social support in the relationship between perceived stress, domains of social support and antenatal depressive or anxiety symptoms (Figure 8.1). The stress-buffering hypothesis suggests that social support directly contributes to the well-being of individuals by

enhancing positive affect and perceived self-worth (main effect). However, social support may also indirectly improve the well-being of individuals by alleviating stressful conditions or by reducing the impacts of stressful situations (buffering effect) (Cohen & Wills, 1985).

During the application of the stress-buffering hypothesis, we expected that pregnant mothers with increased levels of stress would have a higher risk of depressive or anxiety symptoms. In contrast, it is expected that pregnant women with high social support would have less risk of antenatal depressive or anxiety symptoms. Finally, we hypothesized that social support would mediate or intervene in the effects of levels of stress on antenatal depressive or antenatal anxiety symptoms.

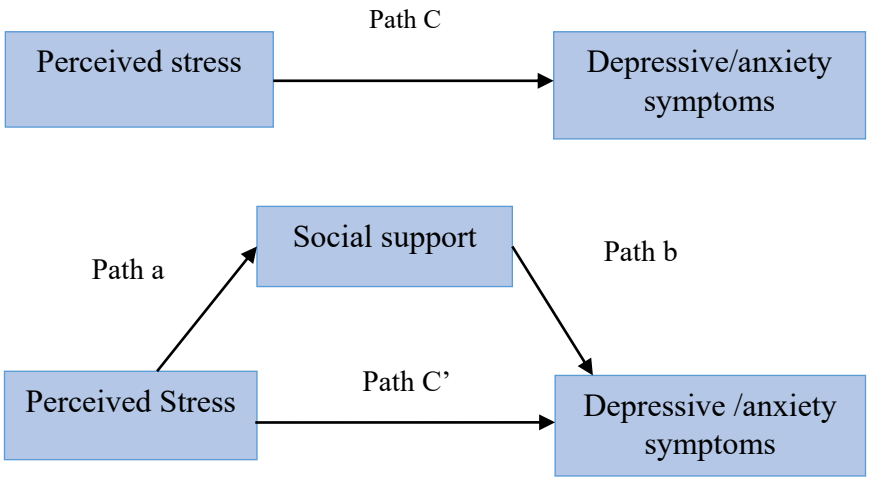

Figure 8.1: The stress-buffering model as the main hypothesis of this study.

Data analysis

The statistical software package SPSS Statistics 26.0 was used for all analyses. The one-way ANOVA and independent-sample t-test were used to examine group mean differences of continuous variables. In addition, an initial correlational analysis was used to test the relationships between stress, domains of social support, and antenatal depressive symptoms and antenatal anxiety symptoms.

The mediational role of social support between perceived stress and antenatal depressive and anxiety symptoms was examined using a mediational analysis model which is conducted using PROCESS macro (version 3.0) for SPSS. For a variable to be considered as a mediator, it

should fulfil the following criteria: (1) the independent variables (stress) should have a strong association with dependent variables (anxiety and/or depression); (2) the independent variables should be strongly related to a mediator (emotional/informational support, affectionate support and tangible support); and (3) independent variables and mediator should be related to outcome variables. However, if the independent variable is no longer significant when the mediator variable is controlled, the finding will be a full mediation effect. If the independent variable still shows a significant association when the mediator is controlled, the finding can be considered as a partial mediation effect (Baron & Kenny, 1986).

Therefore, a 3-step analysis was performed to test the mediating effects of social support in the relationship between stress and antenatal depressive symptoms and antenatal anxiety symptoms. In the first step, each domain of social support is regressed on stress. In the second step, antenatal depressive symptoms and antenatal anxiety symptoms regressed on stress separately. In the third step, the outcome variables (antenatal depressive symptoms and antenatal anxiety symptoms) are regressed on stress and domains of social support separately. The total effect (path c), indirect effects (path a*b) and direct effects (path c') were reported in the form of unstandardized beta coefficients (β). The bootstrapping procedures in the SPSS PROCESS macro from the parallel mediation model 4 were used to test the significance of the indirect effects of stress on antenatal depressive symptoms and antenatal anxiety symptoms through the mediation of each domain of social support (Hayes, 2012). The mediation effect is significant ($p<0.05$) if the 95% confidence interval (CI) for the result of the mediation effect did not contain zero. During the analysis, multicollinearity is not considered a problem if the Variance inflation factor (VIF) values are less than 5 (O'brien, 2007).

Results

Demographic characteristics of pregnant women and group mean differences in stress, social support, depressive and anxiety symptoms are shown in Table 8.1. The mean (Standard Deviation) age of the participants was 35.8 years (1.4), and the majority of participants (65.7%) were between the age of 34-36 years, (95.1%) were married/in a de facto relationship, while (65%) achieved a university degree. The majority of the women (42%) were in the last trimester of their pregnancy, while 37.5% and 20.5% were in the second and first trimesters, respectively.

Marital status was found to be significantly related with domains of social support, and pregnant women who are married/in a de facto relationship reported a higher score of

emotional/informational ($p<0.001$), affectionate ($p<0.001$) and tangible support ($p<0.001$) than those with divorced/single/separated marital status. Also, pregnant women who can easily manage on income available presented less stress level ($p<0.001$), less depressive ($p<0.001$) and anxiety symptoms ($p<0.001$) and a higher score of emotional ($p<0.001$), affectionate ($p<0.001$) and tangible support ($p<0.001$).

Table 8.1: Relationship between demographic characteristics and stress, social support, as well as antenatal depressive and anxiety symptoms among Australian Women, 2021.

Variables	**n (%)**	**Stress (mean ± SD)**	**Social support (mean ± SD)**			**Anxiety symptoms (mean ± SD)**	**Depressive symptoms (mean ± SD)**
			Emotional support	Affectionate support	Tangible support		
Age							
34-36	324 (65.7)	0.57(0.397)	4.41(0.735)	4.57(0.586)	4.29(0.798)	3.43(2.447)	5.23(4.262)
37-39	169 (34.3)	0.68(0.471)	4.23(0.868)	4.36(0.776)	4.09(0.857)	3.43(2.288)	5.78(4.278)
P-value		0.008	0.022	0.001	0.012	0.994	0.178
Stage of pregnancy							
< 3 month	101(20.5)	0.51(0.386)	4.41(0.735)	4.52(0.611)	4.25(0.799)	3.40(2.350)	5.23(0.897)
3-6 month	185(37.5)	0.64(0.424)	4.27(0.840)	4.44(0.695)	4.19(0.856)	3.54(2.512)	5.30(4.466)
>6 month	207(42)	0.442(0.031)	4.38(0.759)	4.54(0.662)	4.23(0.808)	3.34(2.307)	5.63(4.267)
P-value		0.042	0.266	0.367	0.816	0.717	0.664
Highest qualification							
University	319(65)	0.60(0.412)	4.38(0.752)	4.53(0.646)	4.23(0.826)	3.33(2.321)	5.19(4.071)
Certificate/diploma or trade/apprenticeship	112(22.8)	0.65(0.452)	4.29(0.835)	4.47(0.698)	4.26(0.749)	3.69(2.479)	5.76(4.652)
School only	60(12.2)	0.58(0.457)	4.26(0.873)	4.39(0.698)	4.09(0.934)	3.52(2.561)	5.99(4.576)
P-value		0.492	0.439	0.298	0.383	0.389	0.268
Marital status							
Married/De facto relationship	468(95.1)	0.60(0.426)	4.38(0.765)	4.52(0.649)	4.25(0.802)	3.43(2.396)	5.34(4.222)

Divorced/single/separated	24(4.9)	0.74(0.426)	3.78(0.990)	3.99(0.770)	3.59(0.989)	3.50(2.207)	7.06(4.945)
P-value		0.108	<0.001	<0.001	<0.001	0.893	0.054
Able to manage on income available							
Impossible/Difficult all of the time	43(8.8)	1.06(0.612)	3.57(1.215)	3.91(0.931)	3.60(1.059)	5.10(2.424)	9.42(5.406)
Difficult some of the time	118(24)	0.69(0.416)	4.35(0.715)	4.50(0.602)	4.18(0.870)	3.76(2.367)	5.95(4.632)
Not too bad/It is easy	330(67.2)	0.52(0.353)	4.45(0.680)	4.57(0.606)	4.32(0.733)	3.09(2.278)	4.70(3.625)
P-value		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Note: SD: Standard deviation

Correlations among continuous variables

Table 8.2 presents the results of the correlation analysis. Prior to conducting a mediational analysis, it is necessary to check whether the independent, mediating and dependent variables are correlated with each other. Perceived stress was negatively related to emotional/informational support (r=-0.398, p<0.001), affectionate support (r=-0.433, p<0.001) and tangible support (r=-0.321, p<0.001), and positively related with depressive (r=0.557, p<0.001), and anxiety symptoms (r=0.560, p<0.001). Depressive symptoms were negatively related to emotional/informational support (r=-0.471, p<0.001), affectionate support (r=-0.454, p<0.001) and tangible support (r=-0.359, p<0.001). Similarly, anxiety symptoms were negatively related to emotional/informational support (r=-0.369, p<0.001), affectionate support (r=-0.359, p<0.001) and tangible support (r=-0.289, p<0.001). These bivariate correlations support the following mediation analyses.

Table 8.2: Correlation between age, stress, domains of social support, antenatal depressive and anxiety symptoms among Australian women, 2021.

S.no		**Mean ±SD**	1	2	3	4	5	6
1	Age	35.8 (±1.4)	1					
2	Perceived Stress	0.61(0.42)	0.067	2				
3	Antenatal depression symptoms	5.42(4.27)	0.062	0.557**	3			
4	Antenatal anxiety symptoms	3.43(2.39)	-0.002	0.560**	0.665**	4		
5	Emotional/Informational support	4.35(0.78)	-0.119**	-0.398**	-0.471**	-0.369**	5	
6	Affectionate support/Positive social interaction	4.50(0.66)	-0.168**	-0.433**	-0.454**	-0.359**	0.828**	6
7	Tangible support	4.22(0.82)	-0.139**	-0.321**	-0.359**	-0.289**	0.676**	0.673**

Note: **Correlation is significant at the p<0.01 level (2-tailed).

The mediational role of social support

The first mediational analysis was performed to examine the mediational role of social support on the linkage between stress and antenatal depressive symptoms. The results presented in Table 8.3 show that the total effect of stress on antenatal depressive symptoms was statistically significant (β=4.021, p<0.001). With the inclusion of the mediating variables (emotional support/informational support, affectionate support/positive social interaction and tangible support), the effect of stress on antenatal depressive symptoms reduced but remained statistically significant (β=3.549, p<0.001). The indirect effect of perceived stress on antenatal depressive symptoms through affectionate support/positive social interaction (β=0.044, 95%CI: -0.325, 0.405) and tangible support (β=0.056, 95%CI: -0.142, 0.274) was statistically non-significant. However, the indirect effect of perceived stress on antenatal depressive symptoms through emotional/informational social support was found to be statistically significant (β=0.371, 95%CI: 0.067, 0.799). This implies the relationship between perceived stress and antenatal depressive symptoms is partially mediated by emotional/informational support. The display of the parallel mediation model was presented in Figure 8.2.

Table 8.3: Bootstrapping indirect effect and 95% confidence interval (CI) for the mediational analysis in the relationship between perceived stress and antenatal depressive and anxiety symptoms among Australian women, 2021.

Effect	SE	β coefficient (effect)	*P*-value	95% CI
Indirect effect (a*b)				
Perceived stress→Emotional/informational support→ depressive symptoms‡	0.189	0.371	-	(0.067, 0.799)*
Perceived tress→Affectionate support/positive social interaction→depressive symptoms‡	0.184	0.044	-	(-0.325, 0.405)
Perceived stress →Tangible support→depressive symptoms‡	0.102	0.056	-	(-0.142, 0.274)
Perceived stress →emotinal/informational support→anxiety symptoms¥	0.113	0.217	-	(0.029, 0.462)*
Perceived stress →affectionate support/positive social interaction→anxiety symptoms¥	0.109	-0.012	-	(-0.239, 0.198)
Perceived stress →tangible support→anxiety symptoms¥	0.067	0.053	-	(-0.079, 0.194)
Direct effect (c') s				
Perceived tress→depressive symptoms	0.428	3.549	<0.001	(2.708, 4.391)*
Perceived stress →anxiety symptoms	0.246	2.688	<0.001	(2.204, 3.172)*
Total effect (c)				
Perceived tress→ depressive symptoms	0.428	4.021	<0.001	(3.180, 4.863)*
Perceived tress→anxiety symptoms	0.239	2.947	<0.001	(2.477, 3.417)*

‡Model adjusted for sociodemographic factors (Age, marital status), stage of pregnancy, history of miscarriage, life satisfaction and optimism.
¥Model adjusted for sociodemographic factors (Age, marital status), stage of pregnancy, history of miscarriage, and life satisfaction.
**P*<0.001

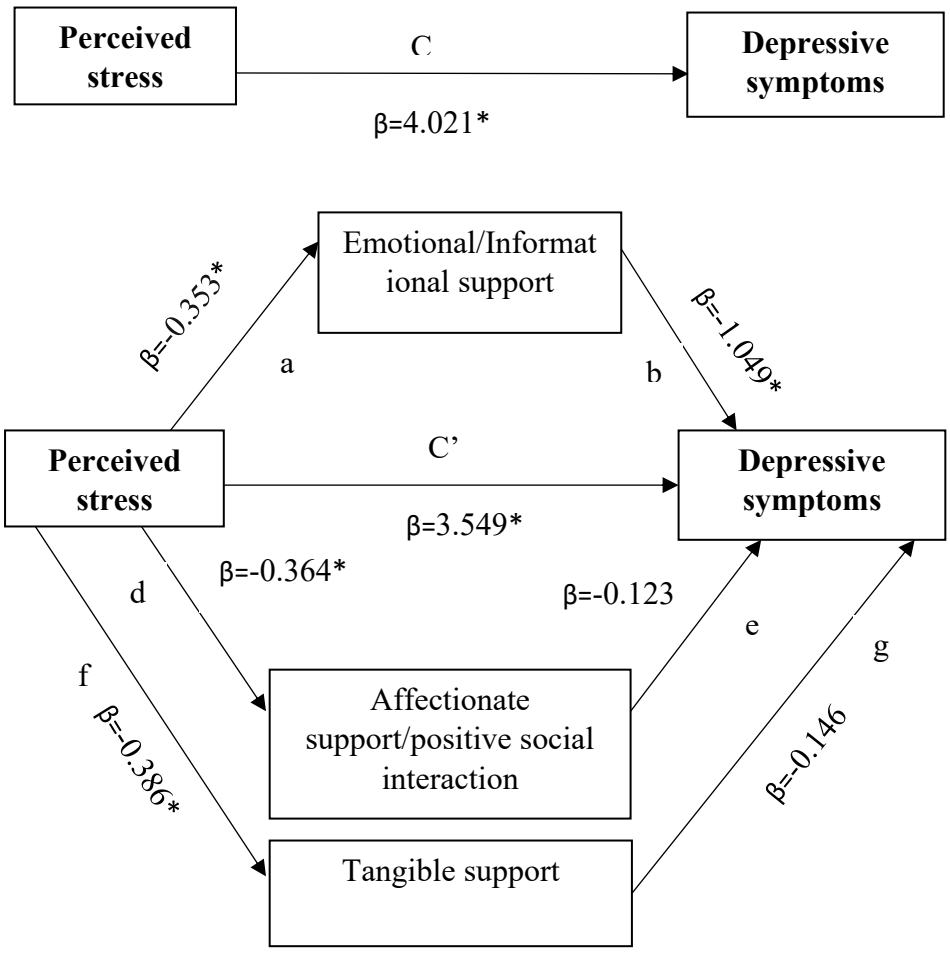

Figure 8.2: Model of the mediating role of domains of social support between perceived stress and antenatal depressive symptoms. Note: **p<0.01.

Similarly, a mediational analysis was performed to examine the mediational role of social support on the relationship between perceived stress and antenatal anxiety symptoms. The results revealed that the total effect of perceived stress on antenatal anxiety symptoms was statistically significant (β=2.947, p<0.001) (Table 8.3). With the inclusion of the mediating variables (emotional support/informational support, affectionate support/positive social interaction and tangible support), the effect of perceived stress on antenatal anxiety symptoms was slightly reduced but remained statistically significant (β=2.688, p<0.001). The indirect effect of perceived stress on antenatal anxiety symptoms through emotional/informational social support was statistically significant (β=0.217, 95%CI: 0.029, 0.462). Therefore, the finding demonstrated that the relationship between perceived stress and antenatal anxiety symptoms is partially mediated by emotional/informational support. However, the indirect effect of perceived stress on antenatal anxiety symptoms through affectionate support/positive social interaction (β=-0.012, 95%CI: -0.239, 0.198) and tangible support (β=0.053, 95%CI: -0.079, 0.194)) was found to be not statistically significant. The display of the parallel mediation model was presented in Figure 8.3.

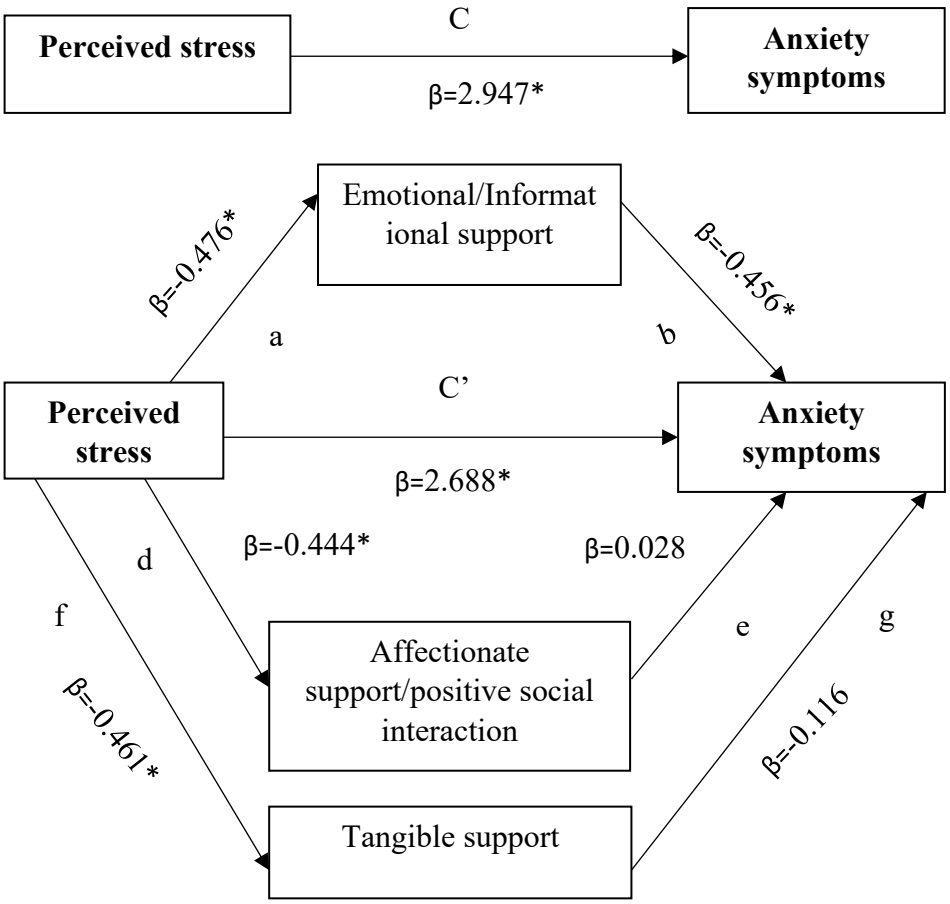

Figure 8.3: Model of the mediating role of domains of social support between perceived stress and anxiety symptoms. Note:**p<0.01.

Discussion

This study aimed to examine the mediating effects of domains of social support in the relationship between stress and depressive and anxiety symptoms during pregnancy among Australian women, demonstrating a number of important findings. This study supplements limited evidence investigating the mediating role of domains of social support in the relationship between perceived stress and antenatal depressive and anxiety symptoms. In fact, this is the first study to examine the mediating effect of specific domains of social support in the linkage between perceived stress and antenatal depressive and antenatal anxiety symptoms among Australian women.

Our study shows that emotional/informational support has a significant partial mediational role in the relationship between stress and antenatal depressive and anxiety symptoms. Conversely, we also found that affectionate support/positive social interaction and tangible support have no significant mediation role in the link between stress and antenatal depressive and antenatal anxiety symptoms.

Two previous studies have assessed the mediational role of overall social support between stress and depressive symptoms (Dadi, Miller, Woodman, et al., 2020; Lau et al., 2014), as well as anxiety symptoms (Lau et al., 2014) among pregnant women. The first was a community-based study conducted among a sample of 755 pregnant Chinese women to investigate the roles of social support in assisting the stress coping ability of pregnant women with depressive and anxiety symptoms. The study found that subjective, objective and total social support each play a significant direct effect on antenatal depression. Besides, this study indicated that social support has a mediating effect in improving antenatal depression and anxiety(Lau et al., 2014). The other study conducted in Gondar, Ethiopia (n=916), has shown that partner and social support partially mediated the association between stressors and antenatal depression (Dadi, Miller, Woodman, et al., 2020). In Australia, an organization known as PANDA (Perinatal Anxiety and Depression Australia) has offered nationwide telephone-based helpline support provided by counsellors for pregnant women and their families experiencing mental health problems which played a significant role for women to recover from perinatal mental illness (http://www.panda.org.au). There is mixed evidence on the effectiveness of telephone support. A randomised control trial (RCT) conducted on assessing the effectiveness of a telephone support program in reducing antenatal mental health problems in New Zealand found the intervention group at 34 weeks of gestation reported less

stress, anxiety and depression levels compared to the control group (Bullock et al., 1995). Another RCT conducted in England among low risk nulliparous pregnant women indicated that telephone support by a midwife did not significantly reduce anxiety (Snaith et al., 2014). Further, a RCT conducted in Canada also found telephone support played an effective role in reducing postnatal depression (Dennis et al., 2009). In contrast, a RCT conducted in the US among pregnant women with a history of at least one spontaneous perinatal loss found that home visits by nurses did not significantly decrease anxiety levels (Côté-Arsenault et al., 2014).

Several mechanisms might explain our study's identified mediational role of emotional/informational support in the linkage between perceived stress and depressive and anxiety symptoms during pregnancy. The first mechanism is the stress-buffering hypothesis, which suggests that social support directly contributes to the well-being of individuals by enhancing positive affect and/or perceived self-worth of individuals and indirectly improve well-being by alleviating stressful conditions (Cohen & Wills, 1985). Second, the linkage between stress, emotional support and depressive or anxiety symptoms during pregnancy can be supported by the psycho-neuroimmunology framework (McnCain et al., 2005), which suggests that the roles of emotional/informational support can change negative responses related to stress, which can help individuals to improve their problem-solving skill and develop a positive view about themselves. This, in turn, can reduce the negative effect stress has on their psychological well-being and reduce the risk of depressive and/or anxiety symptoms (Ngai & Chan, 2012; Xia et al., 2013). Social support gives pregnant women better individual well-being (Gülaçtı, 2010), and those with better psychosocial support tend to cope better with stressful events (Gottlieb & Bergen, 2010). A strong sense of support can later give women the confidence to cope with stressful events without the help of their social network. Social support also significantly affects pregnant women's ability to identify possible stressors (Nasseh Lotf Abadi et al., 2012).

Our study found that affectionate support/positive social interaction and tangible support have no significant mediation role in the linkage between perceived stress and antenatal depressive and anxiety symptoms. These findings did not support our hypothesis that affectionate support/positive social interaction and tangible support plays a significant mediational role in the linkage between perceived stress and antenatal depressive and antenatal anxiety symptoms. One possible reason for this finding is that affectionate/positive social interaction and tangible support were measured using the MOS-SSS-19 scale, which mainly explores the perception of social support and not always reflect the actual available support in which sometimes the actual

social support might not be perceived (Zanini & Peixoto, 2016). Further, the social support finding relies on self-reported data from study participants, which are potentially prone to recall bias. As a result of the above factors, the effects of the mediator variable (affectionate/positive social interaction and tangible support) will be underestimated, and this might result in limited power of our analysis and false identification of a non-significant association.

Some other limitations need to be considered when making inferences from our study findings. First, the study depends on self-reported data from study participants, which has the potential to introduce recall bias. Second, our findings are limited to pregnant women within the age range of 34-39 years, and as such, any interpretation of our findings with regard to other demographics and populations (including younger pregnant women) must be undertaken with caution. Studies have shown that there is variation in the level of antenatal social support across teens (15–19 years) and adult mothers (greater than 20 years) (Figueiredo et al., 2006; Wahn & Nissen, 2008). The level of social support was reported to be less among teen mothers as they had less ability to make and sustain relationships with their social network (Figueiredo et al., 2006; Wahn & Nissen, 2008). Despite these limitations, the significance of our study and findings is strengthened by the fact that our study provided the first analysis of data collected from a nationally representative sample of pregnant women within the age range of 34-39 years.

Conclusion

Our study demonstrated that emotional/informational support has a partial mediating role in the relationship between perceived stress and antenatal depressive and anxiety symptoms. Our study finding suggests that emotional/informational support can play a role in helping reduce the effects of stress, which in turn can reduce the risk of depressive and/or anxiety symptoms during pregnancy. The social support provided over the course of pregnancy may change (Smith & Howard, 2008), and in response, there is much to be gained from conducting a longitudinal study to explore the causative relationship between social support, perceived stress, and depressive and/or anxiety symptoms over the different time periods of pregnancy. As part of routine antenatal care activity, it may be beneficial to integrate valid tools to assess the amount and type of social support received when recording the medical history of pregnant women. In order to further protect pregnant women from the effects of stress, policymakers and maternal health professionals are advised to develop community-based social support programs to enhance antenatal psychosocial support. Such programs should also work to

strengthen the social network of pregnant women and ensure pregnant women have adequate emotional/information support.

Chapter Summary

This chapter has provided the background, methodology and results of a study examining the mediating effects of domains of social support in the relationship between perceived stress and depressive and anxiety symptoms during pregnancy among Australian women. Also, the discussion of the study findings with the previous literature was presented. Finally, the implications, study limitations and conclusion of the finding were presented.

The following chapter will present a study finding examining the direct and mediating effect of social support on HRQoL during pregnancy among Australian women using ALSWHs data.

Chapter 9: The direct and mediating effect of social support on health-related quality of life during pregnancy among Australian women

The study presented in this chapter examined the direct and mediating effect of social support on HRQoL during pregnancy among Australian women. Therefore, this chapter provides insights into the mediating effect of the overall and specific domains of social support in the linkage between perceived stress and HRQoL. Also, this chapter addressed the association between social support and HRQoL among Australian pregnant women.

As shown in the result below, the mediational analysis revealed that emotional/informational support, tangible support and affectionate support/positive social interaction played a significant mediation role in the linkage between perceived stress and mental health-related QoL. Also, the multivariate QR analysis indicated that overall social support and all the specific domains of social support were positively associated with higher MCS. Therefore, maternal health professionals need to consider social support as an essential tool to improve the HRQoL of pregnant women.

The results presented in this chapter have been published in the *BMC Pregnancy and Childbirth* Journal.

> **Bedaso, A**., Adams, J., Peng, W., & Sibbritt, D. (2023). The direct and mediating effect of social support on health-related quality of life during pregnancy among Australian women. BMC Pregnancy Childbirth 23, 372. https://doi.org/10.1186/s12884-023-05708-0.

Abstract

Background: Antenatal stress can have a negative effect on the quality of life (QoL) of pregnant women. Social support plays a vital role in improving the psychological well-being of pregnant women by enhancing their stress-coping ability. The current study assessed the association between social support and health-related quality of life (HRQoL) as well as the mediating role of social support in the linkage between perceived stress and HRQoL among pregnant Australian women.

Methods: Secondary data was obtained from 493 women who reported being pregnant in survey six of the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH). Social support and perceived stress were assessed using the Medical Outcomes Study Social Support Index (MOS-SSS-19) and the Perceived Stress Scale, respectively. The Mental Component Scale (MCS) and Physical Component Scale (PCS) of the SF-36 (Ware & Sherbourne, 1992) were used to examine the mental and physical HRQoL. A mediation model was used to examine the mediating effect of social support in the relationship between perceived stress and HRQoL. A multivariate quantile regression (QR) model was used to assess the association between social support and HRQoL after adjusting for potential confounders.

Result: The mean age of the pregnant women was 35.8 years. The mediational analysis revealed that emotional/informational support (β= -1.53; 95% CI: -2.36, -0.78), tangible support (β= -0.64; 95% CI: -1.29, -0.09), and affectionate support/positive social interaction (β= -1.33; 95% CI: -2.25, -0.48), played a significant mediating role in the relationship between perceived stress and mental health-related QoL. In addition, perceived stress had a significant indirect effect on mental health-related QoL through overall social support (β = -1.38; 95% CI: -2.28, -0.56), and the mediator accounted for approximately 14.3% of the total effect. The multivariate QR analysis indicated that all the domains of social support and overall social support scores were positively associated with higher MCS scores ($p<0.05$). However, social support was found to have no significant association with PCS ($p> 0.05$).

Conclusion: Social support plays a direct and mediating role in improving the HRQoL of pregnant Australian women. Maternal health professionals need to consider social support as an essential tool to improve the HRQoL of pregnant women. Further, as part of routine antenatal care activity, assessing pregnant women's level of social support is beneficial.

Keywords: Health-related quality of life, Social support, Stress, Pregnancy, Mediation

Background

Pregnancy can be stressful time for most women (Guardino & Dunkel Schetter, 2014; Razurel et al., 2013). The occurrence of hormonal and physiological changes (Alzboon & Vural, 2019) and stressful events during pregnancy could negatively affect the physical and mental health of pregnant women, and as a consequence, their quality of life (QoL) will worsen (Calou et al., 2014). QoL is defined as an "individual's perception of their physical and mental health, level of independence, social relationships, personal beliefs, as well as their relationships to their environment" (World Health Organization, 1997).

HRQoL is a sub-component of QoL and is defined as a value given to the duration of life as altered by one's functioning ability and disability, perceptions, and social opportunities as a result of body changes, illness, injury, or treatment (Patrick & Erickson, 1993). Studies have shown that poor HRQoL during pregnancy resulted in low birth-weight infants (Lau, 2013; Wang et al., 2013), higher gestational weight gain (Altazan et al., 2019), experiencing symptoms such as fatigue, back and pelvic pain (Bai et al., 2018) and low HRQoL in the postnatal period (Fobelets et al., 2018). Stress is commonly experienced by pregnant women (Woods et al., 2010), which can have an adverse impact on HRQoL (Lau & Yin, 2011; Shishehgar et al., 2014).

Epidemiological data indicated that the prevalence of stress during pregnancy is 12-36.1% in Canada (Kingston et al., 2012; Whitehead et al., 2003), 78% in the US (Woods et al., 2010) and 95% in China (Tang et al., 2019). A prospective study examining the trend of antenatal stress among Australian women reported the highest prevalence of stress in the early and late stages of pregnancy (Rallis et al., 2014). It has been suggested that stress could exacerbate gestational diabetes mellitus and preeclampsia, which adversely affect the HRQoL of pregnant women (Danyliv et al., 2015; Hoedjes et al., 2011). In addition, a pregnant woman's concerns about her body image and increased weight gain could also contribute to the risk of developing mental health problems such as antenatal anxiety and depression (Leeman & Rogers, 2012; Sahrakorpi et al., 2017), which could lead to poor HRQoL (Da Costa et al., 2010; Silveira et al., 2015).

Factors such as being pregnant at a young age (Park & Choi, 2018), low socioeconomic status (Dağlar et al., 2019), unplanned pregnancy, poor self-care, no antenatal care (Khajehpour et al., 2013), and third trimester of pregnancy (Yim et al., 2015) have all been associated with

poor HRQoL during pregnancy. However, women undertaking the recommended level of physical activity during pregnancy (Campolong et al., 2018), low-parity pregnant women (Balíková & Bužgová, 2014; Dağlar et al., 2019; Mazúchová et al., 2018) and those with first and second trimesters of pregnancy (Vachkova et al., 2013; Wang et al., 2013) were strongly related to a better HRQoL. Further, a systematic review has revealed that high social support and less perceived stress are associated with improved HRQoL during pregnancy (Lagadec et al., 2018).

Social support refers to the provision of emotional, informational, affectionate, and tangible support for somebody through the available social network (Cohen et al., 2004). Followup studies conducted on perinatal women have reported that providing social support can decrease stress and increase the likelihood of recovery, thereby improving the HRQoL (Da Costa et al., 2006; Robertson et al., 2004). It has been suggested that social support interventions and participation effectively prevent antenatal and neonatal adverse birth outcomes by minimising the impact of stress on pregnant women's mental and physical well-being (Glazier et al., 2009; Zachariah, 2009). Social support is also proven highly effective for acute care during life crises (Sintonen & Pehkonen, 2014) and subjective assessment of health states (Frick et al., 2012).

Different models have suggested social support as an area for intervention to improve the HRQoL of pregnant women. The stress-buffering hypothesis suggests that social support could mediate the relationship between perceived stress and HRQoL during pregnancy (Cohen & McKay, 2020). Mainly, social support improves the HRQoL of individuals by enhancing their positive affect and stress coping ability (Cohen & Wills, 1985). Studies have also demonstrated that social support directly affects individuals' HRQoL (i.e., those with less social support have a lower HRQoL than those with higher social support), irrespective of their stress level (Gul et al., 2018; Leung et al., 2014).

However, there is limited evidence reporting the effect of social support on HRQoL among pregnant women. In response to this research gap, our study aimed to examine the direct effect of social support on HRQoL and its mediating role in the linkage between perceived stress and HRQoL.

Method

Data source

This study analysed data from the 1973–78 cohort of the Australian Longitudinal Study on Women's Health (ALSWH) (Brown et al., 1999; Loxton et al., 2018) and reported per the STROBE guideline (supplementary file 8.1). The ALSWH is an ongoing community-based longitudinal study focusing on the health and well-being of Australian women. Over 40,000 women were recruited to participate in 1996 (baseline survey) in three age cohorts (birth year: 1973–78, 1946–51 and 1921–26). Participants were selected randomly via the national health insurance database. Of the 8,010 women who completed Survey 6 of the 1973–78 cohort in 2012 (age between 34-39 years), those who reported being pregnant (n=493) were included in the current analyses (Lee et al., 2005).

Measurement

The Medical Outcomes Study Social Support index (MOS-SSS-19) was used to examine social support given to pregnant women. The MOS-SSS-19 has an overall index of 19 items (Cronbach's alpha 0.81), with higher scores indicating greater social support. The MOS-SSS-19 has three functional support subscales: emotional/informational support, tangible support, and affectionate support/positive social interaction (Sherbourne & Stewart, 1991).

The level of stress in the past 12 months was assessed using the Perceived Stress Questionnaire (Bell & Lee, 2002). The tool measures the level of perceived stress in specific areas, such as relationships and own health. An overall mean stress score ranges from 0 (no stress) to 4 (extreme stress). The tool has good internal reliability (α=0.75) (Bell & Lee, 2003; Bell & Lee, 2006).

The Mental Component Scale (MCS) and Physical Component Scale (PCS) of the SF-36 (Ware & Sherbourne, 1992) were validated by ALSWH and used to examine the mental and physical HRQoL of pregnant women, with higher scores indicating a better QoL. Scores were standardized using Australian norms to get a mean of 50 and a standard deviation of 10 (Ware et al., 1992).

Statistical analysis

The statistical software package SPSS Statistics 26.0 was used for all analyses. The comparison of the PCS and MCS scores between different participant groups was conducted using a t-test and one-way ANOVA. Pearson correlation coefficient was determined to test the relationships between perceived stress, social support, and components of HRQoL (MCS and PCS).

The mediating effect of social support in the linkage between stress and components of HRQoL was examined using the PROCESS macro (version 3.0) for SPSS (Hayes, 2017). A 3-step regression-based analysis was performed to test the mediational role of social support in the relationship between stress and HRQOL (i.e. MCS and PCS). Coefficients for each path (a, b, c, and c') in the mediation model are displayed in Figure 9.1. In the first step, the overall social support score and each domain of social support were regressed on perceived stress (path a). In the second step, HRQoL (i.e. MCS and PCS) was regressed on domains of social support and overall social support (path b). In the third step, the outcome variables (i.e. MCS and PCS) regressed on stress (path c'). Path c' displays the linkage between the independent variable (perceived stress) and the outcome variable (MCS and PCS) by excluding the mediator (social support), whereas path c (total effect) with the inclusion of the mediator. Separate mediation analyses were conducted by considering each domain of social support and overall MOSS-SSS score as a mediator to examine whether there is variation in the mediating effects of each domain of social support.

The mediation effect (indirect effect) (c-c'=a*b) of social support is declared when there is a statistically significant difference between path c and path c' (Mackinnon et al., 1995). The total effect (path c), indirect effects (path a*b) and direct effects (path c') were reported in the form of unstandardized beta coefficients (β). The bootstrapping procedures in the SPSS PROCESS macro from the mediation model 4 were used to test the significance of the indirect effects of perceived stress on HRQoL (i.e. MCS and PCS) through the mediation of social support (Hayes, 2012). During our mediational analysis, heteroscedasticity consistent standard error and adjusted covariance matrix estimator (HC2) were considered to adjust for the abnormal error distribution in the outcome variable (Hayes & Cai, 2007).

The percent mediation (P_M = a*b/c) and R-squared mediation (R^2 med) were also determined. P_M is the ratio of the indirect effect to the total effect and can be interpreted as the percent of the total effect accounted for by the indirect effect (Alwin & Hauser, 1975; Wen & Fan, 2015). R^2 med is the variance of the outcome variable (i.e. MCS and PCS) and can only be explained

by both the independent variable (perceived stress) and mediator (social support) (Fairchild et al., 2009).

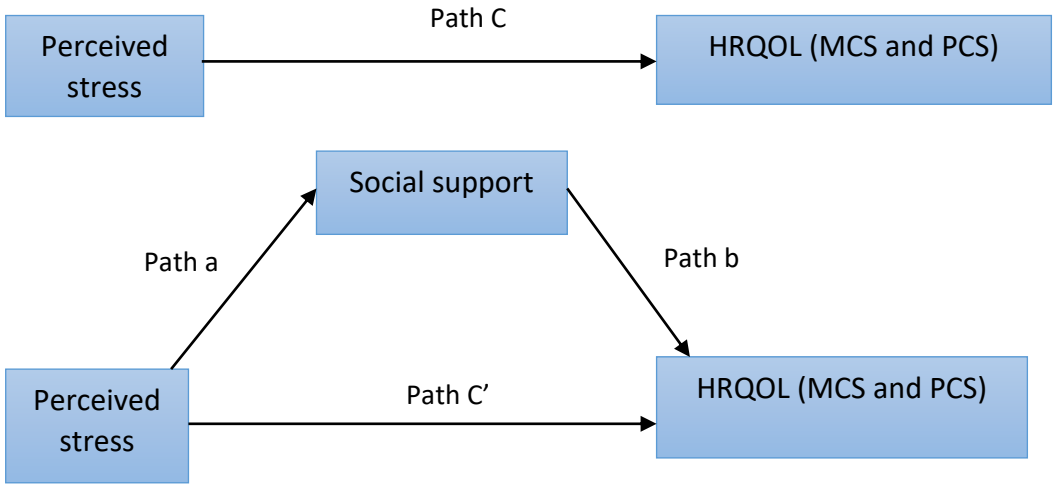

Figure 9.1: The proposed mediation model to examine the mediating effect of social support in the linkage between perceived stress and HRQoL.

The direct effects model states that social support is directly related to its outcome without involving any intermediate variable (Wills & Ainette, 2012). For example, evidence has shown that social support has a direct effect on the quality of life of individuals, irrespective of their level of stress (Gul et al., 2018; Leung et al., 2014). Due to the negatively skewed distribution of both the PCS and MCS, we fitted a multivariate quantile regression (QR) model to examine the direct effect of social support on HRQoL (i.e. PCS and MCS) after adjusting for potential confounders (Davino et al., 2013).

The association between social support and HRQoL was examined at the 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Regression coefficients for each quantile and the corresponding 95% confidence interval (CI) were computed. The adjusted QR controlled for the available potential confounders to examine the association between social support and HRQoL (i.e. MCS and PCS). The association was considered statistically significant at a p-value ≤ 0.05.

Result

The socio-demographic characteristics of study participants are presented in Table 9.1. Of the 493 study participants, 468 (95.1%) were partnered, while 319 (65%) attained a university degree. The majority of these women, 330 (67.2%), responded that it is easy to manage on income available. The mean (Standard Deviation) age of the women was 35.8 (1.4) years. Regarding their gestational age, 42% of women were in the last trimester of their pregnancy.

Results from the bivariate analyses revealed that marital status and pregnancy trimester were significantly related to both MCS and PCS (Table 9.1). Partnered pregnant women reported a higher score of MCS ($p=0.014$) and a lower score of PCS ($p=0.039$) than non-partnered women. Also, pregnant women who were in the last trimester of their pregnancy reported a higher score of MCS ($p=0.001$) and a lower score of PCS ($p<0.001$). The ability to manage available income was significantly associated with the MCS, and pregnant women who can easily manage on income available presented a higher MCS score ($p<0.001$). Note that the mean and median of domains of HRQoL are shown in Supplementary file 9.2.

Table 9.1: Socio-demographic characteristics of study participants and the result of bivariate analyses (n= 493).

Variables	n (%)	MCS		*P*-value	PCS		*P*-value
		Mean	SD		Mean	SD	
Pregnancy months							
< 3 month	101 (20.5)	49.5	6.2	0.001	52.9	6.8	<0.001
3-6 month	185 (37.5)	49.3	8.9		48.2	8.9	
> 6 month	207 (42)	52.0	7.9		42.5	9.6	
Highest qualification							
University	319 (65)	50.9	7.6	0.104	46.3	9.6	0.175
Certificate/diploma or trade/apprenticeship	112 (22.8)	50.2	8.4		47.1	10.0	
School only	60 (12.2)	48.5	9.7		48.7	9.7	
Marital status							
Partnered	468 (95.1)	50.7	7.9	0.014	46.6	9.6	0.039
Non-partnered	24 (4.9)	46.5	9.4		50.7	10.7	
Able to manage on income available							
Impossible/Difficult all of the time	43 (8.8)	43.8	10.3	<0.001	46.4	9.6	0.844
Difficult some of the time	118 (24)	49.8	8.9		46.45	9.6	
Not too bad/It is easy	330 (67.2)	51.6	6.9		46.97	9.7	
Living with one's own children							
Yes	336 (68.3)	50.2	8.4	0.217	46.45	9.8	0.290
No	156 (31.7)	51.1	7.3		47.45	9.51	

Correlations between variables

The result of the correlation analysis was presented in Table 9.2. A significant correlation between the independent, mediating and dependent variables is a prerequisite to conducting a mediational analysis. Perceived stress was negatively associated with emotional/informational support (r= -0.39, p<0.01), affectionate support/positive social interaction (r= -0.43, p<0.01), tangible support (r= -0.32, p<0.01), overall social support (MOS-SSS) (r= -0.41, p<0.01), MCS (r= -0.51, p<0.01) and PCS (r= -0.14, p <0.01). MCS has a positive association with emotional/informational support (r= 0.381, p<0.01), affectionate support/positive social interaction (r= 0.35, p<0.01) and tangible support (r= 0.26, p <0.01). However, the PCS has

no significant correlation with any of the domains of social support, as well as the overall social support score, which fails to meet the assumptions for mediational analysis. Therefore, these correlations only support the assessment of the mediating role of social support in the linkage between perceived stress and MCS.

Table 9.2: Correlations among perceived stress, social support and HRQoL (MCS and PCS).

	Mean (SD)	**Perceived stress**	**MCS**	**PCS**
MOS-SSS	4.36 (0.71)	-0.411**	0.364**	0.054
Emotional/Informational support	4.35 (0.78)	-0.398**	0.381**	0.053
Affectionate support/positive social interaction	4.50 (0.66)	-0.433**	0.358**	0.069
Tangible support	4.22 (0.82)	-0.321**	0.268**	0.031

Note: **correlation coefficient is significant at the p<0.01 level.
Abbreviation: MCS: Mental Component score, PCS: Physical Component Score.

The mediating effect of social support

The findings of the mediational analysis are shown in Table 9.3. Increased overall social support was significantly associated with decreased perceived stress (β = -0.65; 95% CI: -0.83, -0.48) and improved HRQoL (MCS) (β = 2.10; 95% CI: [0.89, 3.32). Perceived stress significantly influenced HRQoL-mental health (MCS) (β = -9.61; 95% CI: -11.25, -7.97), and this relationship was still statistically significant after considering overall social support as a mediator in the model (β = -8.23; 95% CI: -10.05, -6.41).

The mediational analysis revealed a significant indirect effect on HRQOL-mental health domain (MCS) by perceived stress through social support (β = -1.38; 95% CI: -2.28, -0.56), and the mediating variable accounted for around 14.3% of the total effect. The R^2 med value of 0.302 shows that 30.2% of the variance in MCS was due to the indirect effect of perceived stress through overall social support.

A mediational analysis by specific domains of social support as a mediator found a significant mediation effect in all three components. There was a significant indirect effect of perceived stress through emotional/informational support (β= -1.53; 95% CI: -2.36, -0.78), tangible

support (β= -0.64; 95% CI: -1.29, -0.09) and affectionate support (β= -1.33; 95% CI: -2.25, -0.48). The mediating variables, emotional/informational support, tangible support and affectionate support, accounted for 15.9, 6.6 and 13.9% of the total effect, respectively. These results revealed that overall social support and domains of social support partially mediated the relationship between perceived stress and MCS.

Table 9.3: Social support mediates the relationship between perceived stress and HRQoL (MCS) (N= 493).

	Path a	*Path b*	*Path c*	*Path c'*	*Indirect effect (β)*	P_M	R^2_{Med}
Mediational analysis 1: MOS-SSS							
β	-0.656	2.107	-9.613	-8.230	-1.383*	0.143	0.302
LLCI	-0.828	0.892	-11.250	-10.027	-2.285		
ULCI	-0.484	3.321	-7.977	-6.433	-0.564		
Mediational analysis 2: Emotional/informational support							
β	-0.708	2.161	-9.613	-8.082	-1.531*	0.159	0.311
LLCI	-0.903	1.167	-11.250	-9.836	-2.365		
ULCI	-0.513	3.155	-7.977	-6.327	-0.783		
Mediational analysis 3: Affectionate support/positive social interaction							
β	-0.648	2.056	-9.587	-8.254	-1.333*	0.139	0.300
LLCI	-0.796	0.772	-11.224	-10.091	-2.258		
ULCI	-0.499	3.341	-7.950	-6.416	-0.483		
Mediational analysis 4: Tangible support							
β	-0.589	1.088	-9.635	-8.993	-0.641*	0.066	0.286
LLCI	-0.771	0.131	-11.272	-10.713	-1.294		
ULCI	-0.407	2.045	-7.998	-7.274	-0.090		

*Significant association, N.B: Models adjusted for age, highest qualification, and marital status. Abbreviation: LLCI: Lower Limit Confidence Interval; ULCI: Upper-Limit Confidence Interval.

The direct effect of social support on HRQOL (i.e. MCS and PCS)

The results of the multivariate QR analysis examining the direct effects of social support on HRQOL are displayed in Table 9.4. After adjusting for confounders, the β-estimates indicated that all domains of social support and overall social support scores were positively associated with higher MCS scores ($p < 0.05$). Conversely, after adjusting for confounders, social support was found to have no significant association with PCS ($p > 0.05$).

Specifically, emotional/informational support was found to have a statistically significant association with MCS in all four quantiles, highest in the 25th quantile (β= 3.05; 95% CI: 1.97, 4.12) and least in the 90th quantile (β= 1.32, 95% CI: 0.59, 2.06). Furthermore, affectionate support/positive social interaction a significantly associated with MCS in all three quantiles ($p<0.05$) except the 75th quantile (β= 0.15, 95% CI: -0.82, 1.13). At the 25th quantile, the adjusted QR model also indicated a significant ($p < 0.05$) but a 47% reduction in the magnitude of the association between tangible support and MCS (model I vs model II). However, tangible support was not significantly associated with the remaining 50th, 75th, and 90th quantiles ($p > 0.05$).

Overall social support has a significant direct effect on MCS at the 25th (β= 2.71, 95% CI: 1.43, 3.97), 50th (β= 1.41, 95% CI: 0.42, 2.39) and 90th quantiles (β= 0.94, 95% CI: 0.19, 1.68). But the magnitude of association decreased as the distribution of MCS scores changed from the 25th quantile to the 90th quantile.

Table 9.4: Multivariate QR model examining the association between social support and HRQoL (MCS and PCS).

Social support		**Mental Component Score (MCS)**		**Physical Component Score (PCS)**	
		Model I (β coefficient, 95% CI)	Model II‡ (β coefficient, 95% CI)	Model I (β coefficient, 95% CI)	Model II¥ (β coefficient, 95% CI)
Emotional/Informational support	25th Quantile	5.28 (3.91, 6.65)**	3.05 (1.97, 4.12)**	1.41 (-0.45, 3.29)	-1.34 (-2.97, 0.30)
	50th Quantile	3.53 (2.65, 4.40)**	1.23 (0.36, 2.09)*	1.82 (0.13, 3.51)*	-0.06 (-1.30, 1.18)
	75th Quantile	2.33 (1.54, 3.12)**	1.38 (0.57, 2.21)*	0.39 (-0.51, 1.30)	0.62 (-0.54, 1.78)
	90th Quantile	1.87 (0.95, 2.79)**	1.32 (0.59, 2.06)**	0.04 (-0.84, 0.93)	0.54 (-0.27, 1.35)
Affectionate support/ positive social interaction	25th Quantile	5.39 (3.91, 6.87)**	3.15 (1.68, 4.62)**	1.43 (-0.69, 3.57)	-0.04 (-2.0, 1.91)
	50th Quantile	4.20 (3.07, 5.33)**	1.17 (0.08, 2.26)*	2.65 (0.55, 4.74)*	-0.20 (-1.79, 1.38)
	75th Quantile	2.59 (1.65, 3.54)**	0.15 (-0.82, 1.13)	0.81 (-0.30, 1.92)	0.96 (-0.42, 2.34)
	90th Quantile	2.08 (0.95, 3.21)**	1.02 (0.183, 1.86)*	0.16 (-0.93, 1.25)	0.52 (-0.39, 1.44)
Tangible support	25th Quantile	3.33 (2.05, 4.61)**	1.77 (0.65, 2.88)*	1.17 (-0.61, 2.95)	-0.98 (-2.47, 0.51)
	50th Quantile	3.06 (2.14, 3.97)**	0.54 (-0.25, 1.34)	1.15 (-0.55, 2.86)	-0.57 (-1.75, 0.59)
	75th Quantile	1.15 (0.44, 1.86)*	-0.36 (-1.10, 0.37)	0.68 (-0.19, 1.56)	0.22 (-0.81, 1.24)
	90th Quantile	1.01 (0.09, 1.92)*	-0.14 (-0.84, 0.55)	0.23 (-0.65, 1.13)	0.44 (-0.29, 1.18)
Overall social support	25th Quantile	5.54 (4.05, 7.02)**	2.71(1.43, 3.97)**	1.36 (-0.70, 3.42)	-1.15 (-2.94, 0.62)
	50th Quantile	3.88 (2.89, 4.88)**	1.41 (0.42, 2.39)*	1.96 (-0.02, 3.95)	-0.45 (-1.92, 1.01)
	75th Quantile	2.29 (1.38, 3.20)**	0.43 (-0.50, 1.37)	0.88 (-0.14, 1.92)	1.07 (-0.25, 2.40)
	90th Quantile	1.86 (0.82, 2.91)**	0.94 (0.19, 1.68)*	0.14 (-0.89, 1.17)	0.69 (-0.14, 1.52)

*p<0.05; **p<0.001

‡Adjusted for: age, marital status, residence, highest educational qualification, BMI, gestational age, alcohol consumption and perceived stress;

¥Adjusted for age, marital status, residence, highest educational qualification, BMI, Gestational age, Alcohol consumption, perceived stress and physical activity.

Discussion

This study examining the direct effect of social support on HRQoL as well as the mediating effects of social support in the relationship between perceived stress and HRQoL during pregnancy, reveals several important findings. This study supplements limited evidence on the topic and represented the first study to examine the mediating effect of social support in the relationship between perceived stress and HRQoL among pregnant women.

Our results illustrate that overall social support and all three domains of social support have a significant positive association with the HRQoL-mental health domain (MCS) and are negatively associated with perceived stress during pregnancy. In addition, overall social support and all three domains of social support play a significant partial mediational role in the relationship between perceived stress and the HRQoL-mental health domain (MCS). It has been shown that social support plays a similar partial mediating effect in the association between perceived stress and HRQoL among cancer (Mehnert et al., 2010), HIV/AIDS patients (Mizuno et al., 2003), Chinese Shidu parents (Wang et al., 2021) and earthquake survivors (Xu & Wu, 2014). The partial mediating effect of social support is explained by the stress-buffering hypothesis, which suggests that social support contributes to the well-being of individuals by enhancing positive affect, stress-coping ability and perceived self-worth of individuals, which indirectly helps to improve the HRQoL of pregnant women (Cohen & Wills, 1985).

Our study also found that social support is positively associated with the HRQoL-mental health domain. Previous studies also found a significant positive association between social support and HRQoL (Elsenbruch et al., 2007; Emmanuel et al., 2012; MoghaddamHosseini et al., 2021; Ngai & Ngu, 2013). For example, a longitudinal study conducted in Australia among a sample of women (n= 473) found that social support was a significant predictor of the HRQoL-mental health domain during pregnancy and after childbirth (Emmanuel et al., 2012). A study by Vahideh et al. (2016) among 477 Hungarian pregnant women also found that social support had a significant association with better HRQoL both in nulliparous and multiparous women (MoghaddamHosseini et al., 2021). Further, a cross-sectional study conducted in China among a sample of pregnant women (n= 267) also reported the significant direct effect of social support on the mental health component of HRQoL (Ngai & Ngu, 2013). However, none of the above studies examined the direct effect of specific domains of social support (i.e.,

emotional/informational, affectionate, tangible or instrumental support) on HRQoL, which makes our study more robust.

However, the current study also found a non-significant association between social support and HRQoL-physical domain (PCS). A similar finding was reported by a study conducted in Australia (n = 473), where social support did not significantly predict the HRQoL-physical domain during pregnancy or following childbirth (Emmanuel et al., 2012). The study by Emmanuel et al. selected pregnant women from three public hospitals in metropolitan Brisbane, Australia, and it employed SF-12 and Maternal Social Support Scale (MSSS) to examine HRQoL and social support, respectively, at 36 weeks of pregnancy and 6 and 12 weeks after giving birth (Emmanuel et al., 2012).

The findings from our study suggest that to overcome the challenges of stress during pregnancy, it is recommended to integrate social support as an intervention strategy targeting pregnant women suffering from stress. There are two reasons why social support intervention is important. First, social isolation could prevent pregnant women from getting help and other services from the available social support network (Li et al., 2018), which can exacerbate mental health problems and worsen the HRQoL. Second, social support interventions can enhance adherence to other recommended treatments, which helps to improve the subjective feeling of pregnant women, reducing stress and other psychological problems, and as a result, improving the QoL (Li et al., 2018). Pregnant women who receive adequate level of social support pay significant attention to pregnancy-related changes, which in turn could inspire them to engage in good pregnancy care practices (Mabetha et al., 2022). A strong support network helps in improving the HRQoL of pregnant women, thereby protecting pregnant women against stress (Glazier et al., 2009) or providing more favourable socioeconomic conditions (Spencer & Logan, 2002). Conversely, evidence also indicated that low social support significantly predicts health risk factors such as decreased physical activity (Croezen et al., 2012), increased alcohol intake (Croezen et al., 2012), and high BMI (Moak & Agrawal, 2010), which leads to deteriorated HRQoL.

Therefore, such significant effects of social support on HRQoL during pregnancy have an implication for policy and clinical practice. First, maternal health professionals need to consider social support as an essential tool to improve the HRQoL of pregnant women, and there should be routine awareness creation work on the importance of social support during

pregnancy. Second, as part of routine antenatal care activity, it is beneficial to integrate screening tools for assessing the level of social support when recording the medical history of pregnant women during an antenatal care visit. Third, further psychological counselling and incorporating stress management as an intervention would help reduce stress and its subsequent effect on pregnant women's mental and physical health. Fourth, policymakers should work towards establishing community-based social support programs to enhance the wider community's awareness about the role of social support (i.e., support from spouse, family or peer) in improving the well-being of pregnant women. Finally, future longitudinal studies are recommended to explore the causative relationship between social support and HRQoL over different periods of pregnancy.

Limitations

Some limitations need attention when making inferences from our findings. Firstly, the study depends on self-reported data from study participants, which has the potential to introduce recall bias. Second, our study mainly focused on the linkage between perceived stress, social support, and HRQoL. Therefore, other studies are advised to explore additional mediating variables in the relationship between perceived stress and HRQoL. Third, since our study employed a cross-sectional design, causal relationships between the examined variables cannot be determined. Fourth, our findings are limited to pregnant women within the age range of 34-39 years. As such, any interpretation of our findings concerning younger pregnant women must be undertaken with caution.

Conclusion

Our study has shown that social support plays a direct and mediating role in improving the HRQoL-mental health of pregnant Australian women. Thus, social support can play a role in helping reduce the effects of stress, which in turn improves the HRQoL-mental health during pregnancy. Therefore, maternal health professionals need to consider social support as an essential tool to improve the HRQoL of pregnant women. Also, as part of routine antenatal care activity, it is beneficial to assess the level of social support of pregnant women.

Chapter Summary

This chapter has provided the background, methods, results and discussion on a study examining the direct and mediating effect of social support on HRQoL among pregnant Australian women. The study presented and discussed the direct association between antenatal social support and HRQoL with the available literature. Also, the mediational role of overall social support and all three domains of social support in the relationship between perceived stress and the HRQoL-mental health domain (MCS) was presented and discussed. Finally, the implications, study limitations and conclusion of the finding were presented.

The following chapter will cover the general discussion of the thesis, mainly comparing the current finding with the findings of previous studies, summarising the strength and limitations as well as implications of the study findings.

Chapter 10: General Discussion

The discussion sections of the earlier results chapters raise salient issues, findings, limitations, and areas requiring further research effort. This chapter provides a broader context, drawing together a number of new insights emanating from this original research. In addition, this chapter outlines the possible explanations and significance of the major findings. Moreover, this chapter summarises the implications, strengths and limitations of the thesis to better understand the role of social support in preventing antenatal mental health problems and improving the HRQoL of pregnant women.

10.1 Main study findings

10.1.1 Findings of the systematic review and meta-analyses

The systematic review and meta-analysis, presented in Chapter two, Section 4.1, examined the relationship between social support and mental health problems (depression, anxiety, and self-harm) during pregnancy. This systematic review and meta-analysis found that pregnant women who received low social support were more likely to experience mental health problems than pregnant women who received high social support. Specifically, among studies included in the narrative review, most studies reported a significant positive association between low social support and antenatal depression, antenatal anxiety, and/or antenatal self-harm. In addition, the findings of the meta-analysis indicated that low social support was positively associated with antenatal depression and anxiety.

Overall, these results suggest a clear need for implementing targeted screening of pregnant women to ascertain for their level of social support and the provision of targeted social support interventions for pregnant women who had lower levels of social support.

10.1.2 Key findings from the analyses of data obtained from the Australian Longitudinal Study on Women's Health (ALSWH)

As detailed in the background (Chapter one) and literature review section (Chapter two), there are limited studies that examined the prevalence and determinants of low social support and its association with antenatal mental health problems as well as HRQoL. In order to fill these research gaps, ALSWH data was analysed to estimate the prevalence of low social support, identify the determinants of low social support and assess the association between social support and antenatal mental health problems as well as HRQoL. In addition, the analyses examined the mediational role of social support in the association between perceived stress and antenatal mental health problems, as well as HRQoL.

As shown in Chapter 5, it was estimated that 7.1% of pregnant Australian women reported low social support. Further, having mental health problems (i.e. symptoms of depression and/or anxiety), perceived stress, low socio-economic status, and non-partnered marital status are all significant determinants of low social support during pregnancy. Specifically, pregnant women who were non-partnered were four times more likely to receive low emotional support than partnered pregnant women. Pregnant women who have difficulty managing on their available income are three times more likely to receive low emotional and/or low tangible support than women who do not have difficulty managing on their available income. Depression during pregnancy was positively associated with the three domains of social support (i.e. low emotional/informational support, low affectionate/positive social interaction and low tangible support). Further, pregnant women with anxiety symptoms were almost three and nine times more likely to report low emotional and affectionate support than those without anxiety symptoms. Lastly, the current study found a significant association between antenatal stress and low affectionate support.

The results of Chapter six showed that around one in four and one in five pregnant women met the screening criteria for depressive and anxiety symptoms, respectively. Also, the final adjusted model resulted in a significant positive association between low emotional/informational support and antenatal depressive symptoms. Similarly, the likelihood of depressive symptoms was three times higher among pregnant women who reported low social support (overall support) compared with their counterparts without depressive symptoms. Furthermore, it was demonstrated that pregnant women who reported low

affectionate support/positive social interaction had a higher likelihood of anxiety symptoms than pregnant women who reported high affectionate support/positive social interaction. However, there was insufficient statistical evidence for an association between low social support (overall support) and antenatal anxiety symptoms.

Further, Chapter eight presented an examination of the mediating effects of the domains of social support in the relationship between perceived stress and depressive and anxiety symptoms during pregnancy among Australian women. This is the first-ever study to examine the mediating effect of specific domains of social support in the association between perceived stress and antenatal depressive and anxiety symptoms among Australian women. The analyses showed that emotional/informational support has a significant partial mediational role in the relationship between perceived stress and antenatal depressive and anxiety symptoms. Conversely, affectionate support/positive social interaction and tangible support have no significant mediation role in the link between perceived stress and antenatal depressive and antenatal anxiety symptoms.

In Chapter nine, there was an examination of the direct effect of social support on HRQoL as well as the mediating effects of social support in the relationship between perceived stress and HRQoL during pregnancy. The results illustrated that overall social support and all three domains of social support play a significant partial mediational role in the relationship between perceived stress and the HRQoL-mental health domain (MCS). Also, the adjusted multivariate quantile regression model resulted in a significant positive association between social support and the HRQoL-mental health domain. Interestingly, we observed no significant association between social support and HRQoL-physical domain (PCS).

Overall, these results suggest a clear need for implementing targeted screening of pregnant women to ascertain their level of social support and risk of antenatal depression and anxiety. The findings also suggested that social support could be used as an intervention to enhance pregnant women's stress-coping ability, reduce the risk of antenatal mental health problems, and improve the HRQoL-mental health domain.

10.1.3 Key findings of analyses of linked NSW health administrative datasets

Finally, in Chapter seven, there was an examination of the association between marital status and antenatal mental disorders among Australian pregnant women using the NSW-linked health administrative datasets. The study found that non-partnered pregnant women were more likely to suffer from a depressive disorder, anxiety disorder or self-harm than partnered pregnant women. Specifically, antenatal depressive disorder is two times more likely among non-partnered pregnant women than their partnered counterparts. Also, the risk of antenatal anxiety disorder and self-harm was three-fold and two-fold higher among non-partnered women, respectively.

These findings suggest the importance of routine antenatal screening of non-partnered pregnant women for depressive disorder, anxiety disorder and self-harm as well as the need for targeted individual or community-based social support programs to reduce the risk of antenatal mental health problems. Community-based social support is a non-medical care program which can be designed to enhance the health and wellbeing of individuals whose poor health is attributable to one or more of a range of social, economic and environmental factors.

10.2 Discussion of key findings

10.2.1 Prevalence and determinants of low social support during pregnancy

As shown in Chapter five, it was estimated that 7.1% of pregnant Australian women reported low social support. The reported prevalence in the current finding was lower than the prevalence of a study conducted at Royal Women's Hospital in Brisbane, where 28.4% of pregnant women reported poor social support (Webster et al., 2000). In another Australian study using a sample of 600 pregnant women, the prevalence of low overall perceived social support was 11%, slightly higher than our study finding (Spry et al., 2021). This difference in reported prevalence could be due to utilising different social support tools and other demographic characteristics. For instance, the study conducted in Brisbane (n= 990, a mean age of 27.4 years) examined social support using a self-reported six-item Maternity Social Support Scale and classified social support as high/low based on the average total score (Webster et al., 2000). The study conducted in Victoria (participants aged 29–35 years) also used Maternity social support scale but defined low social support as an overall mean score ≤

10th percentile. In our study, the study participants were between the age range of 34-39 years, and 95% were married, and the likelihood of support is higher compared with other studies that employed participants with young age and non-partnered marital status.

In addition, antenatal mental health problems (depressive and/or anxiety symptoms), perceived stress, low socio-economic status, and non-partnered marital status were all identified as significant determinants of low social support during pregnancy. This finding could have important clinical implications for maternity health professionals in terms of screening for the level of social support during antenatal care follow-up, as well as the development of policies to help enhance antenatal social support and the psychological well-being of pregnant women.

Non-partnered marital status was a significant determinant of low social support during pregnancy. Those not partnered were also more likely to report low emotional support than partnered pregnant women. It is highly likely that non-partnered pregnant women lack support from a companion and report low emotional or informational support (Figueiredo et al., 2006; Wahn & Nissen, 2008). A marital partner has been identified as one of the most important social support networks and the key source of emotional and affectionate support for pregnant women (Eaton, 1978). It should also be noted that compared to non-partnered women, partnered women have psychological and social advantages, but this is limited only to those living in a satisfactory relationship status (Kaplan & DeLongis, 1983). Pregnant women in a violent relationship status are more likely to report no or less social support compared to pregnant women in a non-violent relationship status (Hamberger & Arnold, 1990). The current significant linkage between marital status and low antenatal social support was supported by previous studies conducted in the US (Cohen et al., 2014), Sweden (Wahn & Nissen, 2008) and Portugal (Figueiredo et al., 2006). However, the non-significant association was also reported by cross-sectional studies based in Iran (Rafiei et al., 2019) and Brazil (Peter et al., 2017). The use of different social support measures, variation in confounder adjustment, sample size and demographic characteristics of participants could account for the observed difference in findings between the current and previous studies (Peter et al., 2017; Rafiei et al., 2019).

Pregnant women experiencing difficulty managing available income are more likely to report low emotional/informational and tangible support. This concept was supported by a study conducted in Germany, which identified that socially disadvantaged persons more often report

poor social networks and social support compared with their counterparts (Weyers et al., 2008). Also, pregnant women with a higher household income predict better social support based on reports of a study conducted in Mexico (Sciarra & Ponterotto, 1998). It is argued that individuals in a low socio-economic status tend to have a more limited relational radius and report self-isolation from social events because involvement in social activities requires money to afford events which might lead them to self-neglect from society (Bourdieu, 1982). Moreover, withdrawal from society and having fewer friends may lead to feelings of loneliness and to receiving low emotional support and/or low affectionate support from the social environment, including family, friends and spouse (Nobis & El-Kayed, 2019).

This thesis also reported a significant association between antenatal mental health problems and low social support. Further, antenatal stress was significantly associated with low affectionate support. Pregnant women who screened positive for depressive symptoms were more likely to report low emotional/informational support, low affectionate/positive social interaction and/or low tangible support. Finally, pregnant women with antenatal anxiety symptoms are more likely to receive low emotional and affectionate support. Previous studies also reported a significant association between low social support and antenatal depression (Rafiei et al., 2019), as well as parental anxiety (Peter et al., 2017).

Evidence shows that individuals with depression tend to withdraw from social support and communicate with fewer family members or friends, or they might feel more mistrustful and underestimate the level of existing support (Ibarra-Rovillard & Kuiper, 2011). Moreover, the significant linkage between depression and low social support might be because, in the current study, participants were asked to provide a self-report of depressive symptoms one week before the day of completing the questionnaire. Therefore, being depressed may affect the perception of social support, leading to underestimating the support received (Gariepy et al., 2016). Further, depressed individuals induce negative responses and create interpersonal difficulties in their interactions with their social support network, leading to avoidance or rejection by others (Ibarra-Rovillard & Kuiper, 2011; Oxman & Hull, 1997; Stice et al., 2004). The interpersonal accounts of depression also suggest that negative self-evaluation and social inadequacy manifested by depressed individuals disrupt social interactions (Joiner Jr, 2002; Rudolph et al., 2008). Also, it has been established that anxiety impairs social interaction, leading individuals with this disorder to experience loneliness and potentially face disruption to their communication within their social network (Peter et al., 2017).

Further, individuals with high levels of stress may be less able to keep contact with their social network, thus keeping others at a distance, possibly because they fear that they might convey their high stress to their social networks (Coyne & Downey, 1991). In addition, individuals with anxiety symptoms (Falcone et al., 2016) and stress (Ioannou et al., 2019) are typically involved in their own concerns and do not acknowledge the support received. As a result, the likelihood of low social support from family, friends and the community will be evident. Given the cross-sectional design employed in the analyses presented in this thesis, it was impossible to model the reverse causation between low social support and antenatal depression and anxiety. As such, this issue requires further longitudinal investigation with the adjustment of additional potential confounders. Maternal health professionals should routinely screen pregnant women for these significant factors to identify those at risk of low social support. In addition, it will provide valuable information so that the available prenatal mental health policies can be revised to help enhance antenatal social support and the psychological well-being of pregnant women.

10.2.2 The relationship between social support and antenatal mental health problems

In Chapter six, it was estimated that approximately one in four and one in five pregnant women met the screening criteria for depressive and anxiety symptoms, respectively. The final adjusted model resulted in a significant positive association between low emotional/informational support and antenatal depressive symptoms, but no significant associations were found for the other domains of social support. While considering the overall social support score, the likelihood of depressive symptoms was three times higher among pregnant women who reported low social support (overall support) compared with their counterparts. A significant link between low social support and antenatal depression is also supported by a finding from the systematic review and meta-analysis presented in Chapter 2, section 2.1. Several studies conducted in Australia and globally supported the positive link between low social support and antenatal depressive symptoms. For example, a study conducted in Australia found that overall social support was negatively related to antenatal depression (Leigh & Milgrom, 2008). Similarly, the current study findings are congruent with a cross-sectional study conducted in Turkey, which indicated that emotional and instrumental support from the a woman's mother-in-law and general support from the woman's husband had an inverse relation with antenatal depression (Senturk et al., 2011). Further, studies conducted in Sweden (Rubertsson et al., 2003), US (Spoozak et al., 2009), Finland (Pajulo et al., 2001), and China (Tang et al., 2019)

have reported a positive association between low social support and antenatal depression. However, except for the study from Turkey (Senturk et al., 2011), none of the above-mentioned studies examined the relationship between specific domains of social support and antenatal depressive symptoms, which makes the current study more robust.

Pregnant women with low emotional or informational support may not have someone to confide in, obtain necessary information/advice from, or who can help reduce the negative emotions associated with a distressing situation which might expose them to stress and then lead to depression (Thoits, 1986). The findings from the current study have an important implication for clinical practice, as the results suggest that emotional and informational support that is provided to mothers (e.g., listen to you when you need help with daily tasks, advice, etc.) is more important than other forms of support (e.g., getting a hug or feeling wanted, get together, etc.). Also, the current result highlights an important area for intervention, as social support is usually available and provided to pregnant women during antenatal visits via nurses, midwifery or GP and other social support networks. Pregnant women reporting low social support are most vulnerable to antenatal depression; as such, they should be linked to the available social support network to seek emotional and informational support. However, pregnant women who screened positive for antenatal depression may be less likely to pursue this support (Ibarra-Rovillard & Kuiper, 2011). Therefore, maternal healthcare workers should also work to enhance the understanding of pregnant women on the importance of social support to encourage the affected women to seek help.

The results presented in Chapter Six also demonstrated a significant association between low affectionate support/positive social interaction and antenatal anxiety symptoms. A significant link between low social support and antenatal anxiety has also been supported by a finding from the systematic review and meta-analysis (Chapter 4, section 4.1). Evidence showed that pregnant women with low social support are less satisfied with family relationships and poor in interacting with the social environment, and as a result, may be lonely, weakened in stress-coping ability and later become more anxious (Alden & Mellings, 2004; Thoits, 1986). The findings presented in Chapter 6 also revealed insufficient statistical evidence for an association between low social support (overall support) and antenatal anxiety symptoms. A similar non-significant association between low social support and antenatal anxiety was also reported from facility-based studies conducted in Greece (Gourounti et al., 2013) and Canada (Dunkel Schetter et al., 2016). Studies conducted in the US (Cheng et al., 2016), China (Gao et al., 2019;

Tang et al., 2019), and Germany (Martini et al., 2015) have all reported a significant link between low social support and antenatal anxiety symptoms. The possible reasons for inconsistency between the current and the previous findings may be due to the difference across studies regarding the demographic characteristics of participants, the instrument used to examine social support and the adjustment of potential confounders. For instance, the study conducted in the US (Cheng et al., 2016) employed the Turner Support Scale to assess only partner support given to pregnant women and adjusted only for confounders like maternal race/ethnicity, age, parity, education, pre-pregnancy BMI, and household income. However, the current study used the 19-item MOS-SSS scale (Sherbourne & Stewart, 1991) to examine the overall and specific domains of social support and adjusted for potential confounders from the sociodemographic, behavioural and psychological characteristics of participants (Chapter 6). The finding presented in Chapter six also highlights an important intervention area (e.g., screening those reporting low affectionate support and positive social interaction and providing supportive treatment) for maternal healthcare workers.

10.2.3 The mediational role of social support in the relationship between perceived stress and antenatal mental health problems

Chapter eight presented the mediating effects of social support in the relationship between perceived stress and antenatal depressive and anxiety symptoms among Australian women. This is the first-ever study to examine the mediating effect of specific domains of social support in the linkage between perceived stress and antenatal depressive and anxiety symptoms among Australian women. The analyses revealed that emotional/informational support has a significant partial mediational role in the relationship between perceived stress and antenatal depressive and anxiety symptoms. Conversely, affectionate support/positive social interaction and tangible support have no significant mediation role in the link between perceived stress and antenatal depressive and antenatal anxiety symptoms.

Support for the current finding comes from previous studies that assessed the mediational role of overall social support between stress and depressive symptoms (Dadi, Miller, Woodman, et al., 2020; Lau et al., 2014), as well as anxiety symptoms (Lau et al., 2014) among pregnant women. The first was a community-based study conducted among pregnant Chinese women to investigate the roles of social support in assisting the stress-coping ability of pregnant women with depressive and anxiety symptoms (Lau et al., 2014). The study found that subjective,

objective and total social support each play a significant direct effect on antenatal depression. Further, this study indicated that social support has a mediating effect in improving antenatal depression and anxiety (Lau et al., 2014). The other study conducted in Gondar, Ethiopia, showed that partner and social support partially mediated the association between stressors and antenatal depression (Dadi, Miller, Woodman, et al., 2020).

Several mechanisms could help explain the mediational role of emotional/informational support. The first mechanism is the stress-buffering hypothesis, which proposes that social support directly contributes to the well-being of individuals by enhancing positive affect and/or perceived self-worth and indirectly improving well-being by alleviating stressful conditions (Cohen & Wills, 1985). Second, the linkage between Stress, emotional support and depressive or anxiety symptoms during pregnancy can be supported by the psycho-neuroimmunology framework (McnCain et al., 2005), which suggests that the roles of emotional/informational support can change negative responses related to stress, which can help individuals to improve their problem-solving skill and develop a positive view about themselves. This, in turn, can decrease the negative effect of stress on their psychological well-being and reduce the risk of depression and/or anxiety (Ngai & Chan, 2012; Xia et al., 2013). Also, support for the significant mediational role of social support in the current study comes from a previous study, which has shown that individuals with constructive social relations and social support enjoy more efficient communication skills, which enhances protection from mental health problems (Ghasemipoor & Jahanbakhsh, 2010).

10.2.4 The relationship between social support and HRQoL during pregnancy

The results presented in Chapter nine revealed that overall social support and all three domains of social support play a significant partial mediational role in the link between perceived stress and the HRQoL-mental health domain (MCS). Previous studies have shown that social support plays a similar partial mediating effect in the association between perceived stress and HRQoL among Cancer (Mehnert et al., 2010), HIV/AIDS patients (Mizuno et al., 2003), Chinese Shidu parents (Wang et al., 2021) and earthquake survivors (Xu & Wu, 2014). However, no previous study examined the mediation role of social support in the link between antenatal stress and HRQoL. The partial mediating effect of social support in the current study can be explained by the stress-buffering hypothesis, which suggests that social support contributes to an individual's well-being by enhancing positive affect, stress-coping ability and their perceived

self-worth of individuals, which helps to improve the HRQoL-mental health domain (MCS) (Cohen & Wills, 1985).

Also, in Chapter nine, the adjusted model revealed a significant positive link between social support and the HRQoL-mental health domain. Previous studies have also found a significant positive association between social support and HRQoL (Elsenbruch et al., 2007; Emmanuel et al., 2012; MoghaddamHosseini et al., 2021; Ngai & Ngu, 2013). For example, a longitudinal study conducted in Australia among a sample of women found that social support was a significant predictor of the HRQoL-mental health domain during pregnancy and after childbirth (Emmanuel et al., 2012). A study from Hungary by Vahideh et al. (2016) also reported a significant association between antenatal social support and improved HRQoL in nulliparous and multiparous pregnant women (MoghaddamHosseini et al., 2021). Further, a cross-sectional study conducted in China among a sample of pregnant women also reported the significant direct effect of social support on the mental health component of HRQoL (Ngai & Ngu, 2013). However, none of the above studies examined the direct effect of specific social support domains on HRQoL, making the current study more robust. The current study also found a non-significant association between social support and HRQoL-physical domain (PCS). A similar finding was reported by a study conducted in Australia (n= 473), where social support did not significantly predict the HRQoL-physical domain during pregnancy or following childbirth (Emmanuel et al., 2012). The study by Emmanuel et al. selected pregnant women from three public hospitals in metropolitan Brisbane, Australia and employed SF-12 and Maternal Social Support Scale (MSSS) to examine HRQoL and social support, respectively, at 36 weeks of pregnancy and 6 and 12 weeks after giving birth (Emmanuel et al., 2012).

The findings presented in Chapter nine suggest implementing targeted social support as an intervention to overcome the challenges of stress during pregnancy and alleviate suffering. There are suggested reasons why social support is essential. First, social isolation could prevent pregnant women from seeking help and services from their available social support network (Li et al., 2018); these circumstances may exacerbate mental health problems and deteriorate HRQoL. Second, social support (i.e., mainly emotional or informational support from healthcare workers or other social networks) can enhance treatment adherence, improve individual subjective feelings, reduce stress, and result in subsequent improvement of QoL (Li et al., 2018). Moreover, pregnant women who receive adequate social support pay significant

attention to pregnancy-related changes, which could inspire them to engage in good pregnancy care practices and subsequently resulted in improved HRQoL (Mabetha et al., 2022). In contrast, it has been reported that low social support significantly predicts health risk factors such as reduced physical activity (Croezen et al., 2012), increased alcohol intake (Croezen et al., 2012), and high BMI (Moak & Agrawal, 2010), which leads to worsened HRQoL.

10.2.5 The relationship between marital status and antenatal mental health disorders

Finally, the analyses presented in Chapter seven, using the NSW-linked health administrative data, demonstrated the relationship between marital status and antenatal mental disorders among Australian pregnant women. The analyses revealed that non-partnered pregnant women were more likely than partnered pregnant women to suffer from antenatal mental health problems. Various international epidemiological studies also found that non-partnered pregnant women have a higher risk of depressive symptoms during the antenatal period compared to partnered women (Adewuya et al., 2007; Brittain et al., 2015; Fadzil et al., 2013; Faisal-Cury & Menezes, 2007; Gemta, 2015; Mossie et al., 2017; Weobong et al., 2014). Furthermore, previous research conducted in Victoria, Australia (Bilszta et al., 2008) has revealed that single mothers report higher levels of antenatal depressive symptoms than women with supportive partners. Interestingly, this Victorian study also found that single pregnant women reported lower depressive symptoms than those with unsupportive partners (Bilszta et al., 2008). Some studies have reported a non-significant association between marital status and antenatal depression (Agostini et al., 2015; Glazier et al., 2009; Husain et al., 2012; Luke et al., 2009). The non-significant link between marital status and antenatal depression in a study conducted in UK could be due to adjusting confounders such as marital satisfaction, prior history of mental illness and social support (Husain et al., 2012), which was not possible in our study. A study conducted in Italy also adjusted for social support, stressful life events and relationship problem with a partner (Agostini et al., 2015). Therefore, the significant association between marital status and antenatal depression in the current study could be due to insufficient confounder adjustment. Therefore, future studies with robust study design and comprehensive confounder adjustment are recommended to confirm the present finding.

The findings presented in Chapter seven revealed that the risk of antenatal anxiety disorder was three-fold higher among non-partnered women. A similar result comes from studies conducted in Malaysia, Mexico, and Brazil (Fadzil et al., 2013; Faisal-Cury & Menezes, 2007; Salgado

et al., 2019). Conversely, a facility-based study conducted in China Shanghai (n=527) (QIAO et al., 2009) reported a non-significant association between marital status and antenatal anxiety. The possible reason for the non-significant association could be that 98.6% of the study participants were married (QIAO et al., 2009), which can limit the statistical power of the analyses. Therefore, screening pregnant women for anxiety symptoms during their antenatal visit can be an important area of intervention for maternal healthcare workers to identify women at risk of antenatal anxiety.

The findings presented in Chapter seven also revealed that the risk of antenatal self-harm was higher among non-partnered pregnant women than their partnered counterparts. Support for this finding comes from some previous studies (Anbesaw et al., 2021; da Silva et al., 2012) but not all (Giallo et al., 2018) and the US (Newport et al., 2007). For example, a study conducted in Brazil performed a separate regression analysis for depressed pregnant women and found the odds of suicide was higher among non-partnered depressed pregnant women (da Silva et al., 2012). A non-significant linkage between marital status and antenatal self-harm was reported by studies conducted in South Africa (Redinger et al., 2021), Australia (Giallo et al., 2018) and the US (Newport et al., 2007). The non-significant association in a South African study could be due to adjusting for important confounders such as social support, marital stress, relationship with a partner, and previous history of mental illness, which was not possible in our study (Redinger et al., 2021). An Australian study also adjusted additional confounders such as intimate partner violence and fear of partner (Giallo et al., 2018). In a study conducted in US, Only 1 of the study participants attempted suicide during pregnancy, which might be due to the active participation of all study subjects in mental health treatment and willingly participated in the study, which might help in early identification and intervention of suicidal ideation (Newport et al., 2007). Thus, the observed association in the current study could be due to inadequate adjustment of confounders. Further studies with more advanced models confirming this finding are recommended. Finally, screening pregnant women for self-harm during their antenatal visit can be an important area of intervention for maternal healthcare workers to identify women at risk of antenatal self-harm.

10.3 Implications of the findings

10.3.1 Clinical and Public Health Implications

Based on the findings from this study, it appears that there is a need for early screening and interventions for pregnant women with low social support and antenatal mental health problems. Routine screening of pregnant women for mental health problems, low social support and other psychosocial factors can give maternal healthcare workers a chance to identify high-risk pregnant women, provide appropriate interventions and link them to the mental health professional through proper referral pathways for further assessment and treatment. Previous studies have also suggested the importance of antenatal screening of current antenatal mental health problems and other risk factors in preventing both antenatal and postnatal mental health problems (Austin, 2004; Boyce, 2003). This strategy is cost-effective and can be simply initiated by providing training for healthcare workers (Austin, 2004; Boyce, 2003). However, some arguments exist about the importance of antenatal mental health problems and psychosocial screening (Boyce & Judd, 2019; Laios et al., 2013; Reilly et al., 2020). It was argued that not all pregnant women screened positive can attend further mental health examinations (Kim et al., 2010; Reay et al., 2011) or participate in treatment (Bowen et al., 2012; Reay et al., 2011). Some of these issues can be resolved by screening women in a way that has therapeutic value (Khanlari et al., 2019), by giving supportive training for healthcare workers on screening (Avalos et al., 2016) and by linking pregnant women to the available social support programs and other social support networks. The Australian Perinatal Mental Health Care Guideline also recommends screening for mental health problems and other psychosocial factors once or twice during pregnancy and once in the early postpartum periods using an appropriate assessment tool (Austin et al., 2011). Following the introduction of this initiative, the proportion of Australian women screened both during pregnancy and postnatal increased from 21.3% to 79.3%, but still, 21% of women are not screened according to the clinical practice guidelines (Moss et al., 2020). It was also evidenced that the screening rate was much lower in the private health care system and among women over 35 years, Indigenous Australian, single or separated and those with higher income (San Martin Porter et al., 2019). There is a good level of Cochrane evidence that continuity of midwifery care throughout pregnancy, birth, and postpartum conveys positive mental health benefits (Cibralic et al., 2023). Importantly, in the context of a trusting women-carer relationship, women are

more likely to answer screening questions truthfully, disclose difficulties such as intimate partner violence, and engage in recommended health care (Cibralic et al., 2023).

In Chapter eight and Chapter nine of this thesis, social support was found to buffer the effect of stress and reduce the risk of antenatal depression and anxiety, as well as enhance the HRQoL-mental health domain. As such, maternal health professionals need to consider social support as an essential tool to improve pregnant women's mental well-being and HRQoL. Most importantly, maternal health professionals should discuss with pregnant women on the level and source of current social support and monitor pregnant women's mental health status. Specifically, if the pregnant women were non-partnered, more emphasis should be given as the risk of antenatal mental health problems was higher among non-partnered pregnant women (Chapter seven). Therefore, interventions that can motivate pregnant women to use the available personal support networks are necessary. For instance, healthcare workers can directly engage with marital partners, families or peers to discuss the maternal mental health status and give information and training on supporting pregnant women while considering the cultural values and beliefs of the social network. Maternal health professionals and social workers need to mobilise the community through mass media and promote the importance of social support and the supportive role of partners, families and community support groups (i.e., to ensure the future sustainability and effectiveness of the program). WHO defined community mobilisation as the process of bringing together as many stakeholders as possible to raise people's awareness on a particular program and strengthen community participation for sustainability and self-reliance.

Finally, strengthening the provision of psychological counselling and incorporating stress management as an intervention would help reduce stress and its subsequent effect on pregnant women's mental and physical health.

10.3.2 Policy and Research Implications

The results of this study are important in the continuing development of perinatal mental health policy. The current Australian Perinatal Mental Health Care Guideline recommends screening of overall social support and support from a partner and mother (Austin et al., 2017). However, it does not comprehensively assess the specific domains of social support (i.e., emotional or informational support, affectionate support or positive social interaction and tangible support)

(Austin et al., 2017). Therefore, there should be a validated social support tool to comprehensively assess all the domains of social support (i.e., emotional or informational support, affectionate support or positive social interaction and tangible support), to allow healthcare workers to identify the level of support for each domain and provide support for pregnant women. Also, the next updated perinatal mental health policy should include significant determinants of low social support (indicated in Chapter five) to screen and identify pregnant women with low social support.

As shown in Chapter five of this thesis, it was estimated that around 7% of pregnant Australian women reported low social support. Therefore, in addition to the current support provided by the healthcare workers, policymakers and other stakeholders should work towards developing community-based social support programs for pregnant women that can be easily integrated with the current maternal health services. Even though the vast majority of previous studies have viewed social support as an individual-level or interpersonal phenomenon, community psychologists have advised that there should be a new attention shift to community-level structures that can promote social support (Felton & Shinn, 1992; Maton, 2002). Also, community-level groups or associations, such as churches, neighbourhood associations etc., could serve as additional means to promote social support, as these associations are located nearby and highly acceptable by the community (Felton & Shinn, 1992). There were some attempts by some non-profit organisations to support Australian pregnant women who have perinatal mental illness. For example, a non-profit volunteer organisation known as Birthline Pregnancy Support Inc., based in South Australia, has provided emotional support services since 1972 to pregnant women and their families free of cost (https://birthline.org.au/about-us/). Also, an organisation known as PANDA (Perinatal Anxiety and Depression Australia) has offered nationwide telephone-based helpline support since 1983 for pregnant women and their families by counsellors, which plays a significant role in helping women to recover from perinatal mental illness (http://www.panda.org.au). There have also been web-based support networks and programs for pregnant women mainly intended to inform or connect women with each other to share their best practices. For example, the Netmums program in UK, offers information to women on "how to eat healthily, where to meet other mothers, etc." (http://www.netmums.com). Also, a review of 14 RCTs examining the effectiveness of antenatal telephone-based peer support has shown evidence of effectiveness in averting smoking relapse and low birth weight infants (Dennis & Kingston, 2008).

Also, future research is needed to further explore the effect of social support interventions in preventing mental health problems and improving the HRQoL of pregnant women. A review of studies examining the effectiveness of peer support interventions on perinatal depression found that compared with the control group, peer support interventions had a beneficial effect on improving participants' levels of depression (Huang et al., 2020). A randomised control trial (RCT) conducted in New Zealand also reported that telephone-based psychosocial support for pregnant women lowered the level of stress, anxiety and depression in the intervention group (Bullock et al., 1995). Similarly, a RCT of home visitation services for pregnant women by a peer, a social worker, and a nurse significantly increased social support, enhanced care services utilisation, and reduced psychological distress in US (Marcenko & Spence, 1994). However, additional studies have observed conflicting findings (Côté-Arsenault et al., 2014; Snaith et al., 2014). Notably, a RCT conducted in England among low-risk nulliparous pregnant women found that the provision of additional telephone support by a midwife did not significantly reduce the participants' anxiety levels (Snaith et al., 2014) and, a US-based RCT has also reported a non-significant decrease in antenatal anxiety scores among those who received home visits and support from nurses (Côté-Arsenault et al., 2014). The variability in follow-up time and the detail of the practised support intervention (e.g., training for support providers and content of intervention delivered) may partly explain such conflicting results. Despite these complexities and there being much more to examine around the effect of support provided by healthcare workers, it would appear that social support interventions may be a helpful tool in community-level efforts to enhance the mental well-being of pregnant women.

Among the limitations identified in chapter six of this thesis, we cannot confirm the causative linkage between low social support and antenatal depression and anxiety as the data analysis was cross-sectional. Therefore, future researchers should consider longitudinal studies to further explore the causative relationship between low social support and antenatal mental health problems, as well as HRQoL, over different stages of pregnancy. In addition, future qualitative studies exploring pregnant women's perceptions of social support during pregnancy, paying particular attention to their perceptions about the type and content of support, the adequacy of the support received, any self-rated psychological improvement, and their propensity to engage in positive health behaviour as a result of receiving the social support. Finally, future studies examining the relationship between marital status and the risk of antenatal mental health disorders are advised to consider a more vigorous study design and extensive confounder adjustment (e.g., social support, pre-pregnancy mental health problems,

the mental health status of a partner, intimate partner violence, and the length and quality of the marital relationship) to establish a more precise model in order to develop effective interventions.

10.4 Strengths and limitations

Although the strength and limitations of each study were discussed earlier in the corresponding chapters, this section summarises the strength and limitations of the thesis project in it's entirety.

10.4.1 Strengths of the study

The systematic review and meta-analysis included in this thesis constituted the first global-level review to summarise evidence on the linkage between low social support and the risk of antenatal depression, anxiety and self-harm. This comprehensive, rigorously conducted review and meta-analysis followed the PRISMA guideline, and the systematic review was registered prospectively in PROSPERO. A predefined database-specific search strategy was also used to identify eligible studies. Two independent reviewers conducted a quality appraisal of included studies to reduce possible reviewer bias. Moreover, sub-group and sensitivity analyses were conducted to identify the potential source of heterogeneity across studies. The outcome variables were antenatal mental health problems, including depression, anxiety and self-harm, identified using diagnostic or valid screening tools.

One of the strengths of the thesis project is that it draws upon nationally representative data via the ALSWH dataset. The specific domains of social support (i.e., emotional or informational support, affectionate support or positive social interaction and tangible support) were also examined as independent exposure variables rather than considering only overall social support, which was not available in the literature. In the analyses, it was also possible to adjust for several sociodemographic, behavioural, psychological and obstetric characteristics of pregnant women that could potentially confound the relationship between social support and antenatal mental health problems as well as HRQoL, which makes the current study robust. Further, the study examining the association between marital status and the risk of antenatal mental disorders is the first study on the topic and used large population-based high-quality linked health administrative data containing a more comprehensive range of information collected from different sources. Lastly, the assessment of both the exposure (social support)

and outcome variables (antenatal mental health problems and HRQoL) was conducted using a well-validated tool, which makes our findings reliable.

In terms of dissemination, the results of the five primary studies and one systematic review have been published in peer-reviewed journals, where the information can be accessed and used by the scientific community and policymakers as appropriate (Bedaso et al., 2021a, 2021b, 2021c, 2021d, 2023; Bedaso et al., 2022). Likewise, the findings from a systematic review and a primary study were broadcasted in various international media to raise awareness of the link between social support and antenatal mental health problems. Moreover, abstracts of the study findings have been presented at national and international research conferences (Tilahune et al., 2022a, 2022b). Finally, comments and feedback from the journal and abstract reviewers were incorporated to improve the thesis.

10.4.2 Study limitations

The following limitations should be considered when inferring findings from this thesis. In the systematic review and meta-analysis, the literature search was restricted to only include studies published in English, which may lead to publication bias. Also, a significant heterogeneity amongst the studies examining the linkage between social support and antenatal anxiety or depression was observed. This high heterogeneity might be due to the variation in conceptualisation and measurement of social support among the studies included in the review. As a result, working towards a unified social support assessment tool would be helpful.

In addition, the following are the limitations of our primary studies based on ALSWH data. First, the results rely on self-reported data from study participants and are prone to recall bias. Second, possible social desirability bias may have influenced the responses obtained from participants and could result in inflated scores or biased patterns of answers. Third, the results were limited to pregnant women aged 34 to 39 due to a secondary analysis of a pre-existing database. Fourth, using a cross-sectional design in the study raises concerns about an inverse causal relationship between low social support and antenatal mental health problems, such as antenatal depression and anxiety. The cross-sectional study design does not ensure the necessary temporal sequence of events. Therefore, reverse causation is possible and can create a causal nexus that can not be accurately modelled in a cross-sectional design. Fourth, the analyses did not assess the social class of study participants; therefore, it was not possible to

stratify the marital status of study samples with their social class to see if this would affect the prediction of marital status in the social support domain.

Moreover, the following limitations should be considered when inferring the result addressing the linkage between marital status and antenatal mental disorders using NSW-linked data. First, because of an absence of data, it was not possible to adjust for potential confounders such as social support, pre-pregnancy mental health problems, the mental health status of the marital partner, intimate partner violence, and the length and quality of the marriage relationship. Second, more recent data should be considered to further see if the associations identified in our analyses still hold.

Chapter Summary

This chapter has discussed the thesis projects' significant findings within the context of available literature and has highlighted the limitations and strengths of the thesis. The implications of the finding have also been discussed.

Chapter 11: Conclusion

There are five main findings to emerge from this body of original research. First, the findings presented in this thesis revealed that approximately 7.1% of Australian pregnant women reported low social support and that low social support was positively associated with antenatal depression, anxiety, and self-harm. Further, antenatal mental health problems (i.e., antenatal depressive and anxiety symptoms), antenatal stress, low socio-economic status, and non-partnered marital status are all identified as significant determinants of low social support.

The second important finding from the thesis is that low affectionate support/positive social interaction and low emotional/informational support were found to have a significant positive association with antenatal depressive and anxiety symptoms, respectively. Also, around one in four and one in five Australian pregnant women screened positive for depressive and/or anxiety symptoms, respectively.

Third, analyses of data from NSW-linked health administrative data found that non-partnered pregnant women had a higher likelihood of depressive disorder and anxiety disorder compared with partnered women. Furthermore, the likelihood of experiencing self-harm was two times higher among non-partnered pregnant women than among partnered pregnant women.

The fourth finding, which was presented in chapter seven, dealt with the mediational role of social support in the linkage between perceived stress and antenatal depression and anxiety. The finding concluded that emotional/informational support partially mediated the link between perceived stress and antenatal depressive and anxiety symptoms. Finally, chapter eight of the thesis also reported that social support plays a direct and mediating role in improving the mental health-related quality of life of pregnant Australian women. Thus, social support can help reduce the influence of antenatal stress, which in turn improves the mental health-related quality of life during pregnancy. However, social support was found to have no significant association with physical HRQoL.

Maternal health professionals need to consider social support as an essential tool to improve pregnant women's HRQoL and mental well-being. Most importantly, maternal health professionals need to discuss with pregnant women about the level and source of current antenatal social support and monitor pregnant women's mental health status. Also, maternal

health professionals should consider encouraging the available social network of pregnant women to improve maternal antenatal social support. Also, as part of routine antenatal care activity, pregnant women should be screened early for the level of social support and antenatal depressive and anxiety symptoms. Besides, it would also be highly beneficial for maternal healthcare professionals to give more emphasis and screen non-partnered pregnant women for social support, antenatal depression, anxiety and self-harm.

Policymakers and other stakeholders should work towards developing a community-based social support program for pregnant women that can be easily integrated with the current maternal health services. Future research should consider interventional studies exploring social support's effectiveness in preventing mental illness and improving HRQoL during pregnancy. Also, future researchers should consider longitudinal studies to explore the causative relationship between low social support and antenatal depressive and anxiety symptoms after adjusting for additional confounders.

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Appendices

Additional file 4.1: PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3-5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 6, Line 154-166
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5, Line 121-127
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 6

Section and Topic	Item #	Checklist item	Location where item is reported
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 7-8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 8, Line 221-222
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 7-8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 8, Line 224-231
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	Page 8& 9, Line 232-251

Section and Topic	Item #	Checklist item	Location where item is reported
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 9, Line 252-255
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Page 8, Line 232
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 9, Line 252-255
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 11-13
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 11-13
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 12, Line 363-367
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 12-13, Line 402-411
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 14, Line 416-429
	23b	Discuss any limitations of the evidence included in the review.	Page 16, Line 490-496
	23c	Discuss any limitations of the review processes used.	

Section and Topic	Item #	Checklist item	Location where item is reported
	23d	Discuss implications of the results for practice, policy, and future research.	Page 16, Line 478-489
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 4, line 125
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 17, Line 529-530
Competing interests	26	Declare any competing interests of review authors.	Page 17, Line 527-528
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 18, Line 538-539

Additional file 4.2: Data extraction sheet used for studies examining the relationship between social support and mental health problems (depression, anxiety and self-harm) among adult pregnant mothers.

S.no	Author	Publication Year	Country	Sample size	Setting	Study design	Tool (Measures)				Result (Evidence of association)	
							Depression	Anxiety	Self-harm	Social support	AOR/r/β	CI (95%)
1												
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24												

Additional file 4.3: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross sectional and Cohort studies

S.no	(Author, Year of pub.)	Representativeness of the sample	Sample size	Non respondent	Ascertainment of the exposure (risk factor)	Comparability (Confounding factors are controlled)	Assessment of outcome	Statistical Analysis	Total score
1	Abujilban SK., et al, 2013	0	1	0	2	1	2	1	7
2	Adewuya AO., et al, 2007	0	1	0	2	1	2	1	7
3	Anindyajati G., et al, 2017	0	0	1	2	1	2	1	7
4	Belay YB., et al, 2018	1	1	0	2	1	1	1	8
5	Biratu A., et al, 2015	1	1	0	2	1	1	1	8
6	Bisetegn TA., et al, 2016	1	0	0	2	1	2	1	7
7	Dong X., et al, 2013	1	0	0	2	2	1	1	7
8	Dudas R., at al, 2012	1	1	0	2	1	1	1	7
9	Duko B., et al, 2019	1	0	0	2	1	2	1	7
10	Gao L., et al, 2019	1	1	0	2	1	2	1	8
11	Golbasi Z., et al, 2010	1	1	0	2	1	1	1	7
12	Gourounti K., et al, 2013	1	1	1	2	1	1	1	8
13	Herbell K., et al, 2019	1	1	0	2	1	1	1	7
14	Jeong H., et al, 2013	1	1	0	2	1	2	1	8
15	Lau Y., et al, 2011	1	0	0	2	1	2	1	7
16	Pajulo M., et al, 2001	1	1	0	2	1	1	1	7

17	Rashid A., et al, 2017	1	0	0	2	1	2	1	7
18	Shafaie FS., et al, 2017	1	1	0	2	1	2	1	8
19	Spoozak L., et al, 2008	1	0	0	2	1	2	1	7
20	Stewart RC., et al, 2014	1	0	1	2	1	1	1	7
21	Verreault N., et al, 2014	1	1	0	2	1	2	1	7
22	Yanikkerem E., at al, 2013	1	1	0	2	1	2	1	8
23	Zeng Y., et al, 2015	1	0	0	2	1	2	1	7
24	Sahile MA., et al, 2017	1	1	0	2	1	2	1	8
25	Records C., et al, 2007	1	1	0	2	1	2	1	8
26	Waqas A., et al, 20115	1	0	1	2	1	2	1	8
27	Jesse ED., et l, 2005	1	0	0	2	2	1	1	8
28	Blaney NT., et al, 2004	1	0	0	2	1	2	1	7
29	Gausia k., et al, 2009	1	1	0	2	1	2	1	8
30	Shidhaye P., et al, 2017	1	1	0	2	1	2	1	8
31	Hartley M., et al, 2011	0	1	0	2	1	2	1	7
32	Rwakarema M et al, 2015	0	1	0	2	1	2	1	7
33	Heyningen T et al, 2015	1	0	0	2	1	2	1	7
34	Onah MN., et al, 2016	1	0	0	2	1	2	1	7
35	Couto T., et al, 2015	0	1	0	2	1	2	1	7
36	Pinheiro RT., et al, 2011	1	1	0	2	1	2	1	7

37	Senturk V., et al, 2011	1	1	0	2	1	2	1	8
38	Glazier RH., et al, 2004	1	0	0	2	1	2	1	7
39	Dibaba Y., et al, 2013	0	1	1	2	1	1	1	7
40	Heyningen T., et al, 2017	1	0	0	2	1	2	1	7
41	Supraja, TA., et al , 2016	1	1	1	2	1	1	1	8

NOS critical appraisal evaluation for Cohort studies

S.no	**(Author, year of pub.)**	**Selection domain**				**Comparability domain**		**Outcome domain**			**Total score* (9)**
		Representativeness of exposed cohort (⋆)	Selection of non-exposed cohort (⋆)	Ascertainment of exposure (⋆)	Outcome of interest was not present at start of study (⋆)	Control for age or substance use or chronic medical illness (⋆)	Control for other variables (2nd important variables) (⋆)	Assessment of outcome (⋆)	Follow-up period (⋆)	Adequacy of follow up (⋆)	
1	Agostini F., et al, 2015	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
2	Akiki S., et al, 2016	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
3	Bayrampour H., et al, 2015	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
4	Bernard O., et al, 2018	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	8
5	Cankorur vs., et al, 2015	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
6	Chee C., et al, 2005	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	0	8
7	Cheng E., et al, 2016	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
8	Clements AD., et al, 2016	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
9	Schetter DC., et al, 2016	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	8

10	Fall A., et al, 2013	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
11	Hain S., et al, 2016	⋆	⋆	⋆	⋆	0	⋆	⋆	⋆	⋆	8
12	Lee AM., et al, 2007	⋆	⋆	⋆	⋆	0	⋆	⋆	⋆	0	7
13	Li Y., et al, 2017	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	0	8
14	Robertson C.et al, 2002	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
15	Sheeba B., et al, 2019	⋆	⋆	⋆	⋆	0	⋆	⋆	⋆	⋆	8
16	Sidebottom AC., et al, 2017	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	8
17	Xian T., et al, 2019	⋆	⋆	⋆	⋆	⋆	0	⋆	⋆	0	7
18	Woldetensay YK., et al, 2018	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
19	Westdahl C., et al, 2008	⋆	⋆	⋆	⋆	0	⋆	⋆	⋆	⋆	8
20	Nasreen HE ., et al, 2011	⋆	⋆	⋆	0	⋆	⋆	⋆	⋆	0	7
21	Leigh B., et al, 2008	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
22	Martini J. et al, 2015	⋆	⋆	⋆	⋆	0	⋆	⋆	⋆	⋆	8
23	Rubertsson C.,et al, 2010	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	0	8
24	Huang M., et al, 2019	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	9
25	Marchesi C., et al, 2014	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	0	8
26	Hartley M., et al, 2011	⋆	⋆	⋆	⋆	⋆	⋆	⋆	⋆	0	8

NB: good quality score ≥7

Additional file 6.1: STROBE Statement—Checklist of items included in reports

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1&2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3&4
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4&5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5*
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6&7
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6&8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA

		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7&8
		(b) Indicate number of participants with missing data for each variable of interest	7&8
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	8&9
Discussion			
Key results	18	Summarize key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

Additional file 6.2: Sensitivity analysis (E-values) for the association between low social support and the risk of antenatal depressive symptoms for the final adjusted model.

Variables	**AOR (95% CI)**	**E-value**	
		For point estimate	For CI
Low emotional/informational support	4.75 (1.45, 15.66)	3.78	1.7
Low social support (overall score)	3.26 (1.05, 10.10)	3.01	1.18

CI: Confidence Interval

Additional file 6.3: Sensitivity analysis (E-values) for the association between low social support and the risk of antenatal anxiety symptoms for the final adjusted model.

Variables	**AOR (95% CI)**	**E-value**	
		For point estimate	For CI
Low affectionate support/positive social interaction	7.43 (1.75, 31.55)	4.89	1.98

CI: Confidence Interval

Additional file 7.1: STROBE Statement—Checklist of items included in reports

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1&2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3&4
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4&5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5&6
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4&5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6&7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6&7
		(b) Give reasons for non-participation at each stage	4&5
		(c) Consider use of a flow diagram	4&5

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8&8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarize key results with reference to study objectives	9-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

Supplementary file 9.1: STROBE Statement—Checklist of items included in reports

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1&2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3&4
Objectives	3	State-specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4&5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	4&5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-7
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	NA

Descriptive data	14*	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarize key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10&12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

Supplementary file 9.2: Mean and median of domains of SF-36 (N=493).

Domain of SF-36	Mean ±SD	Median
Physical functioning	80.11 (20.66)	90.00
Role physical	63.29 (41.85)	75.00
Role emotional	90.06 (25.37)	100.00
Bodily pain	71.60 (20.45)	74.00
Vitality	52.22 (18.02)	55.00
Mental health	77.61 (13.80)	80.00
Social functioning	80.86 (21.36)	87.50
General health	77.84 (15.79)	80.00
MCS	50.48 (8.09)	52.54
PCS	46.79 (9.69)	49.10

Abbreviation: MCS: Mental Component score, PCS: Physical Component Score.