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ORIGINAL RESEARCH

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Rurality as a predictor of perinatal mental health and well-being in an Australian cohort

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Abstract

Objective: Perinatal emotional well-being is more than the presence or absence of depressive and anxiety disorders; it encompasses a wide range of factors that contribute to emotional well-being. This study compares perinatal well-being between women living in metropolitan and rural regions.

Design: Prospective, longitudinal cohort.

Participants/setting: Eight hundred and six women from Victoria and Western Australia recruited before 20 weeks of pregnancy and followed up to 12 months postpartum.

Main outcome measures: Rurality was assessed using the Modified Monash Model (MM Model) with 578 in metropolitan cities MM1, 185 in regional and large rural towns MM2-MM3 and 43 in rural to remote MM4-MM7. The Structured Clinical Interview for DSM-IV (SCID-IV) was administered at recruitment to assess depression, and symptoms of depression and anxiety were measured using the Edinburgh Post-natal Depression Scale and the State and Trait Anxiety Scale, respectively. Other measures included stressful events, diet, exercise, partner support, parenting and sleep.

Results: The prevalence of depressive disorders did not differ across rurality. There was also no difference in breastfeeding cessation, exercise, sleep or partner support. Women living in rural communities and who also had depression reported significantly higher parenting stress than metropolitan women and lower access to parenting activities.

Conclusions: Our study suggests while many of the challenges of the perinatal period were shared between women in all areas, there were important differences in parenting stress and access to activities. Furthermore, these findings suggest that guidelines and interventions designed for perinatal mental health should consider rurality.

KEYWORDS
depression, parenting, perinatal, pregnancy, rural

1 | INTRODUCTION

It is increasingly accepted that emotional well-being in the perinatal period should consider more than merely the presence or absence of depressive and anxiety disorders.[1] Rather, it encompasses a wide range of factors that contribute to emotional well-being and are impacted by pregnancy and early parenting including lifestyle factors, such as diet, exercise and sleep, as well as stressful life events, partner and family support, breastfeeding and parenting stress.[2–5] Many of these factors are also amenable to interventions that may improve emotional well-being and may reduce either the likelihood or the severity of perinatal depression. Equally, factors such as breastfeeding and sleep are frequently impacted by emerging perinatal depression, and these interactions are important to understand.[6–8] While examining the impact of perinatal clinical depressive and anxiety disorders is critical, many women have levels of symptomatology that do not meet DSM criteria for diagnosis of a psychological disorder. While there is research that is focused on exploring the interaction of these varied factors potentially associated with perinatal emotional well-being, such studies are primarily focused on women who reside in metropolitan areas.[9] Including women who live in rural communities is important to further our understanding of perinatal depression and the factors associated with emotional well-being.

In Australia, women in rural areas represent approximately 27% of births, and in many countries, rural populations may represent an even higher proportion of births.[10,11] The current policy and strategic direction for service delivery across Australia, such as outlined in Women-centred care: Strategic Directions for Australian Maternity Services, articulates the principles of providing maternity care close to where a woman lives.[12,13] However, in a rural setting, access to expert care in perinatal mental health can be limited and sometimes is non-existent.[14] To inform policy and practice, there is a need for quality data to increase our understanding of how to improve perinatal mental health across our whole community, including women living rurally.

Research outside of the perinatal period has shown women living rurally during the child-bearing years are significantly less likely to access treatment for depression and anxiety.[15] Research also suggests there are more barriers in rural communities for women with mental rather than physical health concerns.[16] The limited data available on prevalence are restricted to the postpartum period. This has found that post-natal depression is higher in women living in rural communities; although when socioeconomic differences are adjusted for this, difference may become less pronounced.[17–19] Beyond prevalence, there is little consideration of the context or differences between rural communities. In the only systematic review of perinatal depression and rurality we can find, only one longitudinal study was identified, and this had been undertaken in Pakistan.[17]

There are a number of potential differences experienced by women living rurally compared with metropolitan areas in the identification, access and treatment

What is already known on this subject:

- Rurality is associated with more limited access to mental health care particularly in specialist areas, such as perinatal mental health
- While there are limited cross-sectional studies examining perinatal mental health in rural communities, our understanding of any potential differences for rurality in factors which contribute to perinatal mental health is very limited
- Longitudinal studies examining rurality and depression in women across pregnancy and the postpartum for depression are limited, yet given many who live in rural communities have increased risk factors and limited services for perinatal mental health, this research is needed

What this paper adds:

- Across many of the associated factors that contribute to emotional well-being, there was no difference in rural and metropolitan women across pregnancy and the postpartum, including in depression
- However, women from rural communities with depression were found to have higher parenting stress and also reported lower access to parent–infant activities. This suggests there are differences in access and impacts of perinatal depression in rural areas that should be considered in perinatal mental health recommendations and care

for mental health in pregnancy and the postpartum period.[20–22] These may include access to specialist treatment and geographical distances associated with isolation. Possible differences in health promoting lifestyle factors (e.g. diet, exercise, smoking, sleep and alcohol use), social support, stressful life events (including family domestic violence and financial hardship) and the impact of natural environment are all critical to perinatal mental health and emotional well-being. The implications of living in a rural environment will also differ according to the varied contexts and ecological heterogeneity of rural communities. For example, living in a remote mining area is likely to be a considerably different environment than living within a farming community, a coastal regional centre or a remote township.

Given the paucity of robust evidence found in the literature regarding perinatal mental health and emotional well-being in women living rurally, we decided to explore this field broadly to see where further specific studies may bring additional value. In this study, we examine trajectories of women's mental health, emotional well-being, lifestyle and early parenting outcomes during the perinatal period. We aimed at assessing whether these trajectories differ by Australian geographic region, and whether region-specific trajectories impacted by rural adversity further differ by the presence or absence of depression.

2 | METHODS

2.1 | Sample

This study uses data from 806 perinatal women from a prospective pregnancy cohort, the Mercy Pregnancy and Emotional Well-being Study (MPEWS): 578 of whom were recruited from two capital cities in Australia (Melbourne, Victoria and Perth, Western Australia) and 228 of whom were recruited from rural regions mostly in Western Australia. The majority of these 228 women were recruited from a targeted selection of three WA regions to ensure rural diversity in the sample. Specifically, these were the South West, Midwest and Goldfields regions of WA; each region is demographically diverse due to the differences in both current and historical primary industries in each of the regions. Women were recruited before the 20th week of pregnancy (i.e. early pregnancy) and followed up during third trimester, birth, and 6- and 12-month postpartum. Women were recruited into one of three groups: women taking antidepressant medication in pregnancy (AD exposed; $n = 146$), non-medicated women who met diagnostic criteria for a depressive disorder at recruitment (depressed; $n = 86$) and control women ($n = 574$). Further details of the study are described in the published study protocol.[23] Mercy Health Human Research Ethics Committee and the WA South Metropolitan Health Human Research Ethics Committee both approved this study, and all participants provided informed, written consent.

2.2 | Measures

2.2.1 | Mental health outcomes

At recruitment, the Structured Clinical Interview for DSM-IV (SCID-IV) Mood disorders schedule[24] was administered. In addition, self-report symptom measures of depression, anxiety and stressful life events were assessed at recruitment, third trimester, and 6- and 12-month postpartum. Depressive symptoms were measured using the Edinburgh Post-natal Depression Scale (EPDS).[25] This has been validated for use with Australian women during the perinatal period.[26] State anxiety symptoms were measured using the state subscale of the State–Trait Anxiety Inventory (STAI).[27] This has also been validated for use in Australian women in pregnancy.[28] Stressful life events were assessed using a perinatally adapted Stressful Life Events Scale, which includes 24 common stressful life events.[29] The sum of the number of life events at each time point was used in this study.

2.2.2 | Maternal lifestyle outcomes

Sleep quality was measured using the Pittsburgh Sleep Quality Index at early pregnancy, third trimester, and 6- and 12-month postpartum. The PSQI consists of 19 items and is a self-report measure of sleep, which can produce a global sleep quality score. Higher scores indicate poorer sleep quality, and a score greater than five has been used to indicate poor sleep.[30] The PSQI has been validated for use during pregnancy.[31] Weekly exercise frequency was assessed at early pregnancy and third trimester, and at 6- and 12-month postpartum. Specifically, women are asked to self-report the number of days per week they exercised in response to 'Over the last month, how many days per week would you do at least 30 minutes of vigorous physical activity (including activities such as walking briskly, riding a bike, gardening, tennis, swimming, running, etc.?)'. Weekly serves of fruit and vegetables and the number of monthly take-away meals were assessed at third trimester, and 6- and 12-month postpartum using items from the Australian Bureau of Statistics National Nutrition Survey.[32] Social support from a partner was measured using the Social Support Effectiveness Scale, which is

a 10-item self-report scale assessing the usefulness and timeliness of both emotional and task and responsibility support provided by a partner specifically during the perinatal period.[33] The items are summed, with higher scores indicating higher levels of perceived effectiveness of support.

2.2.3 | Post-partum parenting outcomes

Breastfeeding cessation data were collected at 6- and 12-month postpartum. Breastfeeding was the provision of the mother's milk to the baby and could be via expressed milk or directly from the mother. At 6- and 12-month postpartum, stress experienced due to the role of parenting was assessed using the fourth edition Parenting Stress Index-Short Form (PSI-4-SF),[34] which is a 36-item index yielding a total score of overall parenting stress and three subscales (Difficult Child, Parent Distress and Parent–child Dysfunctional Interactions). Percentile scores can be derived from raw scores. Internal consistency of the total score on the PSI is strong.[35] In this study, we utilise the percentile score for the total PSI.

2.2.4 | Region remoteness

We used the Modified Monash Model (MM Model)[36] to classify remoteness. This Model categorises relative access to health resources and services indicated by both the geographical region (Australian Statistical Geographic Standard-Remoteness Area),[37] and road distance and population size of reference cities, towns and communities. The MM Model classifies regions of Australia as metropolitan areas (MM1, 71.33% of the Australian population), regional centres (MM2, 8.99%), large rural towns (MM3, 6.50%), medium rural towns (MM4, 3.97%), small rural towns (MM5, 7.27%), remote communities (MM6, 1.17%) and very remote communities (MM7, 0.77%).[38] Due to smaller numbers in some regions and similarities with respect to access to mental health and perinatal mental health services, we combine MM2 and MM3 (*MM2-MM3*) where there is access to specialist mental health but not perinatal mental health, and, separately, MM4 through MM7 (*MM4-MM7*) where local mental health care is predominantly delivered in primary care. We compare these groups to MM1 where there is access close by to specialist perinatal mental health care, such as public mother baby units. Similar differences in access to specialist maternity and paediatric/child health exist across these three groups within our sample areas.

2.2.5 | Covariates

Maternal age, ethnicity, parity, education and employment were collected at recruitment in early pregnancy. Responses for ethnicity were then coded into the broad ethnicity categories of the Australian Standard Classification of Cultural and Ethnic Groups.[39] Antidepressant type, usage, dosage and timing during pregnancy was self-reported by women, as well as obtained from hospital records at delivery. Perinatal community support was assessed using items from the Communities That Care Youth Survey, modified for the perinatal context.[40] These items assessed mothers' perceptions of accessibility to six common community perinatal resources and services (1—*Very difficult to access*, 5—*Very easy to access*).

2.3 | Statistical analyses

We first provide sociodemographic characteristics for the women by grouped MM region (i.e. MM1, MM2-MM3 and MM4-MM7) and compare the groups using χ^2 and ANOVA tests at each time point. Sociodemographic characteristics that differed between regions were added to models as covariates. We also describe the community and social support characteristics of the regions.

To address the aim of this study, repeat measurement outcomes for maternal mental health, lifestyle and postpartum parenting were modelled using mixed-effects linear models for continuous outcomes and generalised estimating equations for binary (binomial, logit link) and count (negative binomial, log link) outcomes. Time was modelled continuously using follow-up counts (i.e. 1, 2, 4 and 5) as an index for time, and quadratic effects were also modelled (i.e. Time^2) for outcomes with more than two follow-up points of data. For each outcome, two models were tested as follows: an *initial model* that most accurately described the pattern of change in the outcome during the perinatal period by MM region (i.e. change by region models), which included an interaction term between the highest order polynomial of Time with MM region, and a *final adjusted model*, which included fixed effects of rurality and depression, and adjustment for covariates. In all models, MM2-MM3 and M4-MM7 were each compared with MM1 as the reference group. Non-significant interactions terms were omitted prior to reporting and interpreting all initial and final models. In mixed linear models, random effects for intercept and slope were estimated and correlated using an unstructured error covariance assumption. All analyses were conducted using Stata 16.

3 | RESULTS

3.1 | Sociodemographic characteristics

Across the seven MM regions, 578 (71.7%) were living in metropolitan areas (MM1), 71 (8.8%) in regional centres (MM2), 114 (14.1%) in large rural towns (MM3), 9 (1.1%) in medium rural towns (MM4), 24 (3.0%) in small rural towns (MM5), 3 (0.4%) in remote communities (MM6) and 7 (0.9%) in very remote communities (MM7). Table 1 displays the sociodemographic characteristics of the sample across the three MM region groups. The age of women in the sample ranged between 18 and 48, with an average of 32.06 (SD = 4.67), which did not vary between MM1, MM2-MM3 and MM4-MM7. The overall prevalence of a diagnosed depressive disorder was 17.9%, which also did not vary between the regions. The sample were predominantly from Oceanic and European backgrounds, with significantly more diversity observed in the MM1 compared with MM2-MM3. More women in the MM1 compared with MM2-MM3 were nulliparous, and more women from MM1 reported a university education when compared with both MM2-MM3 and MM4-MM7. Overall, rates of smoking and alcohol consumption were low and did not differ significantly across the regions. Although the proportion of depression was similar across the groups, the proportion of women taking antidepressants in MM4-MM7 (7.0%) was less than half that reported by women in the MM1 (19.7%) and MM2-MM3 (15.7%) groups; however, this apparent difference in proportions did not reach statistical significance ($p = 0.069$).

In terms of perinatal community support, women in all groups reported relatively easy access to mothers' groups and maternal and child health centres. However, on average, women living in MM4-MM7 regions reported less ease of access to early learning activities, such as parent–infant

TABLE 1 Early pregnancy demographic characteristics of the MPEWS cohort by MMM Region ($N = 806$)

Characteristic at recruitment (% missing)	MM1 ($n = 578$)		MM2-MM3 ($n = 185$)		MM4-MM7 ($n = 43$)		
	n	%*	*n*	%*	*n*	%*	χ^2 *p*-value
Oceanic/European backgrounds (3.6%)	481	85.4[a]	165	94.8[b]	37	92.5[a,b]	0.001†
Nulliparous	423	73.2[a]	81	43.8[b]	27	62.8[a,b]	<0.001
Married, de facto or otherwise committed relationship (7.9%)	517	96.8	169	100	39	100	0.028†
University education (4.1%)	375	66.8[a]	87	50.6[b]	16	40.0[b]	<0.001†
Depressive disorder	98	17.0	38	20.5	8	18.6	0.537
Antidepressant use	114	19.7	29	15.7	3	7.0	0.069
Smoking (5.6%)							
None	503	91.0	163	97.0	37	92.5	0.164†
<1 cigarette per day	7	1.3	1	0.6	0	0.0	
1–5 cigarettes per day	23	4.2	1	0.6	1	2.5	
More than 5 cigarettes per day	20	3.6	3	1.8	2	5.0	
Alcohol (4.7%)							
None	403	72.6	146	83.9	34	87.2	0.092†
1 standard drink or less per month	103	18.6	16	9.2	4	10.3	
2–3 standard drinks per month	24	4.3	6	3.4	1	2.6	
1 standard drink per week	9	1.6	1	0.6	0	0.0	
2 or more standard drinks per week	16	2.9	5	2.9	0	0.0	
Characteristic (% missing)	**M (SD)**	**Min-Max**	**M (SD)**	**Min-Max**	**M (SD)**	**Min-Max**	***F* p-value**
Maternal age at recruitment (0%)	32.21 (4.66)	19–48	31.82 (4.52)	20–46	31.04 (5.33)	19–44	0.207

Note: Superscript letters that differ between cells denote significant pairwise differences at $p < 0.05$ in between-group column proportions.

Abbreviations: MM1, metropolitan areas; MM2-MM3, regional centres and large rural towns; MM4-MM7, medium and small rural towns, and remote and very remote communities.

*Valid percentages are presented; missing data handled case-wise.

†Significance of Fisher's exact test reported due to expected cell counts <5.

dance, parent–infant swimming and baby-gym, compared with women in MM1 and MM2-MM3 regions. In terms of perceived adequacy of social support, there were no differences in reported support from parents and parents-in-law. Overall, 56.5% of the sample reported having a parent or parent-in-law living close by. However, more women in MM4-MM7 reported having parents or parents-in-law living within the same state, but not nearby, compared with more women in both MM1 and MM2-MM3 regions who reported having parents and parents-in-law living interstate or overseas.

3.2 | Comparison of perinatal outcomes between women across MM region groups

Figure 1 displays estimated means of the maternal mental health, lifestyle and post-partum parenting outcomes for the MM region groups, derived from the initial change by region regression models with the best-fitting modelling for time (i.e. linear or quadratic).

3.2.1 | Mental health outcomes

Figures 1a–c display region-average trajectories of depressive symptoms, state anxiety symptoms and the number of stressful life events, respectively, and the model estimates are reported in Table 2. There were no significant quadratic effects of Time detected in the mental health outcome models. Although average state anxiety symptoms were reducing by a small amount at each subsequent follow-up for women in all groups, depressive symptoms were stable across the perinatal period. In Figure 1a, average depressive symptoms (EPDS) were significantly lower in women from MM2-MM3 than MM1. These patterns of mental health were not different after adding covariates in the final adjusted model. Compared with the steadily reducing number of stressful life events reported by women in MM1 across the perinatal period, women in MM2-MM3 reported a significantly stronger reduction in stressful events at each subsequent follow-up. In the final adjusted model for stressful life events, depression was associated with more stressful life events for women in all groups; however, this effect was significantly stronger in women with depression living in MM2-MM3 than MM1. There were no three-way interactions between time point, region and depressive disorder, suggesting that MM region-average trajectories of mental health were not significantly different between women with and without a depressive disorder.

3.2.2 | Lifestyle outcomes

Figures 1d–h display region-average trajectories of lifestyle outcomes, specifically global sleep quality, days per week of moderate exercise, weekly fruit and vegetable intake, monthly take-away meal intake and perceived adequacy of partner support, respectively, with modelling estimates reported in Table 3. Global sleep quality became poorer between early pregnancy and 12-month postpartum, inclusive, for women in all groups; however, the rate at which sleep quality became poorer slowed, and improved between 6- and 12-month postpartum. These patterns of change in sleep quality did not differ by MM region; however, depression was associated with significantly poorer sleep quality. The number of days spent exercising was steady for women in all groups during the perinatal period. In the final adjusted model, for all groups, depression was associated with 15% average reduction in the weekly rate of exercising across the perinatal period. Weekly fruit and vegetable intake reduced significantly from the third trimester to the 6-month postpartum, but the reduction weakened significantly to 12-month postpartum. This pattern remained in the final adjusted model; however, there was a significant time * MM region interaction, such that fruit and vegetable intake between third trimester and 6-month postpartum did not reduce as strongly for women in both MM2-MM3 and MM4-MM7 when compared with women in MM1. The number of take-away meals per month increased by 95% from the baseline rate between third trimester and the postpartum for women in both the MM1 and MM2-MM3, but the initial increase slowed by 22% between 6- and 12-month postpartum. Compared with MM1 and MM2-MM3 regions, monthly take-away meal intake did not increase between third trimester and 6-month postpartum for women in the MM4-MM7 but did increase between 6- and 12-month postpartum. This pattern of monthly take-away meals did not change in

FIGURE 1 Estimated Marginal Means derived from the Change by MM Region models for *maternal mental health outcomes* ((a), Depressive symptoms; (b), State anxiety symptoms; (c), Stressful life events) *maternal lifestyle outcomes* ((d), global sleep quality; (e), Number of days per week of moderate-intensity exercise; (f), Number of serves of fruit and vegetable per week; (g), Number of take-away meals per month; (h), Perceived partner support), and *post-partum parenting outcomes* ((i), Breastfeeding cessation; (j), Parenting stress)). *X-axis scale legend*: 1—Early Pregnancy; 2—Third Trimester; 4—6-month Postpartum; 5—12-month Postpartum. EPDS, Edinburgh Post-natal Depression Scale; PSI, Parenting Stress Scale; PSQI, Pittsburgh Sleep Quality Index; SLES, Stressful Life Events Scale; SSE, Social Support Effectiveness Scale; STAI-S, State Trait Anxiety Inventory-State Scale.

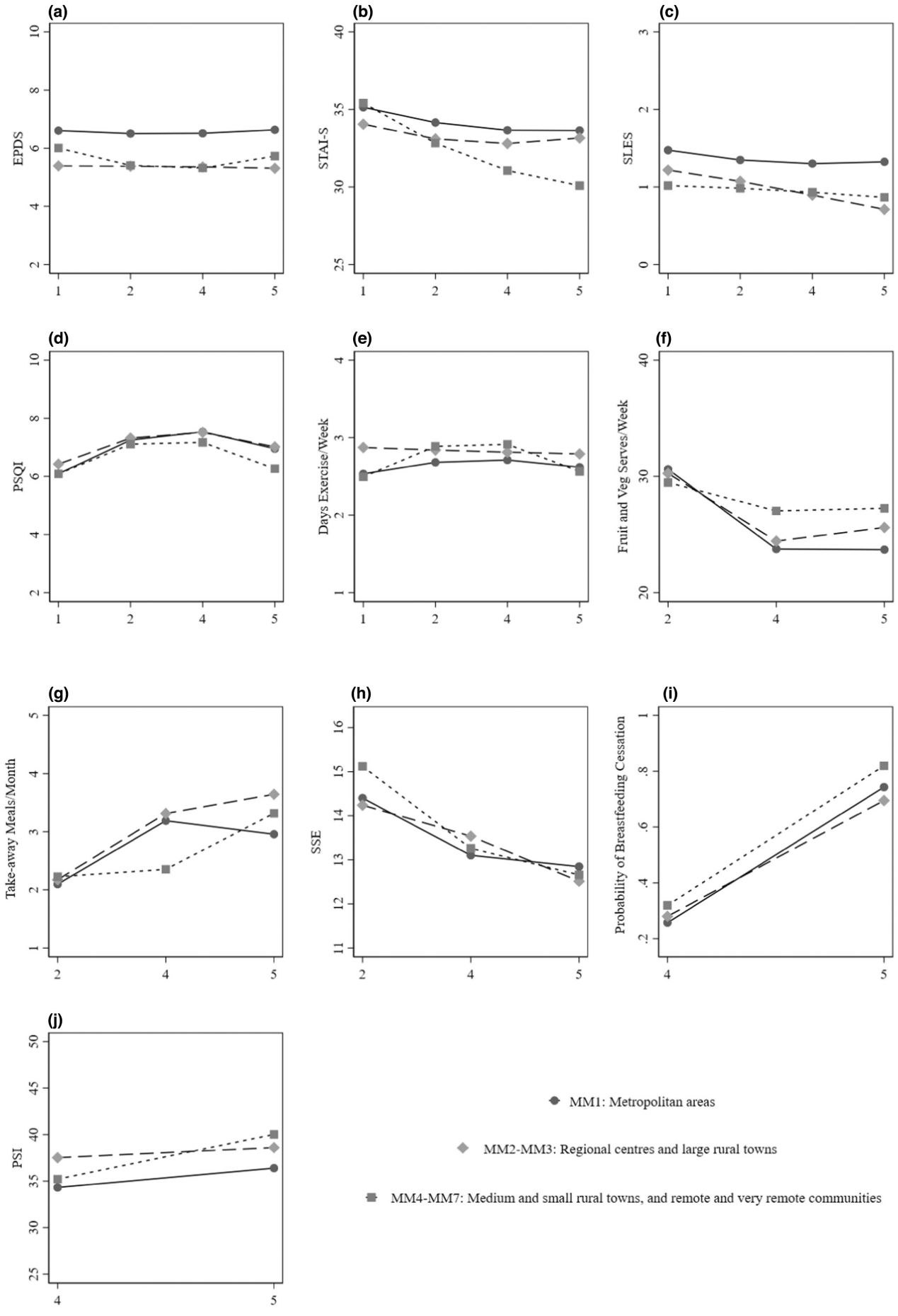

TABLE 2 Estimates for initial change by MMM region and final adjusted maternal mental health mixed regression and generalised estimating equation models ($N = 806$)

	Initial change by region model			Final adjusted model		
	b/IRR	Robust SE	95% CI	*b*/IRR	Robust SE	95% CI
Depressive symptoms						
Intercept	6.58	0.19	6.20, 6.95	7.64	1.01	5.66, 9.63
Time (follow-up)	−0.02	0.06	−0.14, 0.11	−0.01	0.07	−0.14, 0.12
Depression	–	–	–	3.28***	0.37	2.56, 4.01
MM2-MM3 *c.f.* MM1	−1.19**	0.35	−1.86, −0.51	−1.25***	0.34	−1.92, −0.59
MM4-MM7 *c.f.* MM1	−0.95	0.64	−2.21, 0.31	−0.75	0.61	−1.95, 0.44
State anxiety symptoms						
Intercept	34.99	0.43	34.16, 35.83	37.00	2.22	32.65, 41.35
Time (follow-up)	−0.59***	0.14	−0.86, −0.31	−0.53***	0.14	−0.81, −0.26
Depression	–	–	–	7.07***	0.81	5.48, 8.67
MM2-MM3 *c.f.* MM1	−0.85	0.74	−2.31, 0.61	−1.07	0.74	−2.53, 0.37
MM4-MM7 *c.f.* MM1	−1.95	1.38	−4.66, 0.76	−1.46	1.32	−4.05, 1.14
Stressful life events (*IRR*)						
Intercept (baseline rate)	1.46	0.07	1.32, 1.61	1.84	0.5	1.09, 3.12
Time (follow-up)	0.96*	0.02	0.91, 0.99	0.95*	0.02	0.91, 0.99
Depression	–	–	–	1.25*	0.13	1.02, 1.54
MM2-MM3 *c.f.* MM1	0.85	0.09	0.68, 1.05	0.78	0.1	0.61, 1.01
MM4-MM7 *c.f.* MM1	0.7	0.16	0.45, 1.10	0.86	0.21	0.53, 1.40
Depression * MM Region						
MM2-MM3 *c.f.* MM1	–	–	–	1.50*	0.28	1.03, 2.16
MM4-MM7 *c.f.* MM1	–	–	–	0.69	0.28	0.30, 1.54
Time * MM Region						
MM2-MM3 *c.f.* MM1	0.88*	0.05	0.79, 0.98	0.88*	0.05	0.78, 0.98
MM4-MM7 *c.f.* MM1	0.99	0.11	0.81, 1.22	0.99	0.10	0.81, 1.20

Note: All models include the following covariates: ethnicity, maternal age (centred at 32 years of age), parity, relationship status, university education and antidepressant use in pregnancy. Depressive symptoms, anxious symptoms and stressful life events models include data across early pregnancy (recruitment), third trimester, and 6- and 12-month postpartum.

Abbreviations: *b*, regression coefficient; CI, confidence interval; IRR, incidence rate ratio; MM1, metropolitan areas; MM2-MM3, regional centres and large rural towns; MM4-MM7, medium and small rural towns, and remote and very remote communities; SE, standard error.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

the final adjusted model, with no significant differences in region-specific trajectories due to depression.

Perceived social support effectiveness received from a partner decreased significantly between third trimester in to the postpartum for women in all groups, but this reduction slowed significantly in the postpartum across the sample. Following addition of covariates, these patterns in social support effectiveness did not differ in the final adjusted model, and the average trajectory did not differ significantly by MM region and depression.

3.2.3 | Post-partum parenting outcomes

Figure 1i,j display region-average trajectories of breastfeeding cessation and parenting stress, respectively, and the model estimates reported in Table 4. The odds of breastfeeding cessation increased significantly between 6- and 12-month postpartum for women in all groups, remaining significant in the final adjusted models. There were no differences in these significantly higher odds by MM region and depression. For parenting stress, the initial change model by region showed no significantly different trajectories between MM regions. In fact, parenting stress increased significantly, on average, for women in all groups. In the final adjusted model, the sample-average increase in parenting stress between 6 and 12 months remained, and depression was a significant predictor of higher parenting stress across the sample. In addition, average parenting stress across the postpartum was significantly higher for women in the MM2-MM3 region than in the MM1 region. Overall, parenting stress trajectory

TABLE 3 Estimates for initial change by region and final adjusted maternal lifestyle mixed regression and generalised estimating equation models ($N = 806$)

	Initial change by region model			Final adjusted model		
	***b*/IRR**	**Robust SE**	**95% CI**	***b*/IRR**	**Robust SE**	**95% CI**
Sleep quality						
Intercept	6.14	0.14	5.86, 6.42	6.34	0.77	5.12, 8.15
Time (follow-up)	1.51***	0.15	1.21, 1.82	1.54***	0.16	1.24, 1.85
Time^2	−0.42***	0.05	−0.52, −0.32	−0.43***	0.05	−0.53, −0.33
Depression	–	–	–	1.79***	0.28	1.24, 2.33
MM2-MM3 *c.f.* MM1	0.14	0.25	−0.34, 0.62	0.10	0.26	−0.40, 0.60
MM4-MM7 *c.f.* MM1	−0.24	0.46	−1.13, 0.66	−0.16	0.46	−1.06, 0.75
Days Exercising per Week (*IRR*)						
Intercept (baseline rate)	2.6	0.07	2.46, 2.75	1.59	0.24	1.19, 2.14
Time (follow-up)	1.01	0.01	0.99, 1.03	1.01	0.01	0.99, 1.03
Depression	–	–	–	0.85**	0.04	0.77, 0.94
MM2-MM3 *c.f.* MM1	1.07	0.05	0.98, 1.17	1.07	0.05	0.97, 1.17
MM4-MM7 *c.f.* MM1	1.04	0.10	0.86, 1.25	1.05	0.10	0.87, 1.26
Fruit and Vegetable Intake per Week (*IRR*)						
Intercept (baseline rate)	30.57	0.53	29.54, 31.64	22.38	2.33	18.25, 27.46
Time (follow-up)	0.69***	0.03	0.63, 0.74	0.69***	0.03	0.63, 0.75
Time^2	1.13***	0.02	1.08, 1.18	1.13***	0.02	1.08, 1.17
Depression	–	–	–	0.97	0.04	0.91, 1.06
MM2-MM3 *c.f.* MM1	0.99	0.04	0.92, 1.05	0.98	0.04	0.91, 1.06
MM4-MM7 *c.f.* MM1	1.00	0.08	0.85, 1.17	1.02	0.09	0.87, 1.21
Time * MM Region						
MM2-MM3 *c.f.* MM1	1.05	0.02	1.00, 1.10	1.05*	0.03	1.01, 1.11
MM4-MM7 *c.f.* MM1	1.09*	0.05	1.01, 1.19	1.11*	0.05	1.01, 1.21
Take-away food intake per month (IRR)						
Intercept (baseline rate)	2.01	0.09	1.93, 2.28	2.68	0.48	1.88, 3.82
Time (follow-up)	1.95***	0.15	1.68, 2.25	2.01***	0.15	1.74, 2.33
Time^2	0.78***	0.03	0.72, 0.85	0.77***	0.03	0.71, 0.84
Depression	–	–	–	1.18*	0.10	1.01, 1.39
MM2-MM3 *c.f.* MM1	1.04	0.08	0.90, 1.20	1.03	0.09	0.88, 1.21
MM4-MM7 *c.f.* MM1	1.06	0.20	0.74, 1.52	0.93	0.17	0.65, 1.35
Time * MM Region						
MM2-MM3 *c.f.* MM1	0.92	0.1	0.74, 1.15	0.89	0.10	0.71, 1.11
MM4-MM7 *c.f.* MM1	0.47***	0.10	0.31, 0.71	0.47**	0.11	0.30, 0.74
Time^2 * MM Region						
MM2-MM3 *c.f.* MM1	1.09	0.07	0.96, 1.23	1.10	0.07	0.96, 1.25
MM4-MM7 *c.f.* MM1	1.48**	0.19	1.15, 1.90	1.52**	0.20	1.16, 1.97
Perceived partner support						
Intercept	14.39	0.15	14.09, 14.69	14.24	0.84	12.59, 15.90
Time (follow-up)	−1.53***	0.30	−2.13, −0.94	−1.55***	0.31	−2.16, −0.94
Time^2	0.36*	0.15	0.07, 0.65	0.34*	0.15	0.04, 0.64
Depression	–	–	–	−1.15***	0.30	−1.74, −0.56

(Continues)

TABLE 3 (Continued)

	Initial change by region model			Final adjusted model		
	b/IRR	Robust SE	95% CI	*b*/IRR	Robust SE	95% CI
MM2-MM3 *c.f.* MM1	−0.002	0.26	−0.51, 0.51	0.07	0.28	−0.47, 0.62
MM4-MM7 *c.f.* MM1	0.30	0.49	−0.66, 1.26	0.36	0.5	−0.62, 1.34

Note: All models include the following covariates: ethnicity, maternal age (centred at 32 years of age), parity, relationship status, university education and antidepressant use in pregnancy. Sleep quality and days exercising per week models include data across early pregnancy (recruitment), third trimester, and 6- and 12-month postpartum; fruit and vegetable intake, take-away meals and perceived partner support models include data from third trimester and 6- and 12-month postpartum.

Abbreviations: *b*, regression coefficient; IRR, incidence rate ratio; MM1, metropolitan areas; MM2-MM3, regional centres and large rural towns; MM4-MM7, medium and small rural towns, and remote and very remote communities; SE, standard error; CI, confidence interval.

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

between 6- and 12-month postpartum did not vary by depression diagnosis.

4 | DISCUSSION

This study compared women from metropolitan areas (i.e. MM1) with women from two distinct rural regions (i.e. MM2-MM3: Regional Centres and large rural towns and MM4-MM7: Medium and small rural towns, and remote and very remote communities) within a pregnancy cohort study using the same protocol including measures of mental health, lifestyle and parenting. Comparing these three groups showed that at recruitment, there was no difference in the prevalence of those with current depressive disorders measured using a diagnostic clinical interview. While depressive disorders did not differ between these groups of women, those who resided in rural areas had trajectories of lower symptoms of both depression and anxiety over the perinatal period and reported fewer stressful events than women residing in metropolitan regions. However, women in rural communities with depression reported significantly higher parenting stress than metropolitan women with depression or non-depressed women across all jurisdictions. Furthermore, it was those in MM2-MM3 regional centres who were more significantly impacted than those from more isolated communities.

There was no difference across the perinatal period in timing of breastfeeding cessation or partner and family support in rural compared with metropolitan women whether depressed or not. There was no difference for maternal reported sleep or exercise across pregnancy and the postpartum for rural and metropolitan women. Women living in rural communities did have higher fruit and vegetable intake in the perinatal period. Women in MM4-MM7 reported less access to parenting activities and supports. Parenting activities and supports, such as joint music activities, supported group play activities, and other supports have been associated with improving bonding and mental health in new parents and this gap in access for rural families is concerning.[41]

There are very few longitudinal pregnancy cohort studies conducted in women in rural communities and even fewer with a metropolitan comparison sample and with a focus on depression. Only one longitudinal study was identified in a systematic review of perinatal depression and rurality, and since that review, while additional rural longitudinal cohort studies have been identified, none have a metropolitan comparison group or robust measurement of depression.[17,42,43] These studies have also been undertaken in the context of low- and middle-income countries making comparison with rural communities within a high-income country, such as Australia, problematic.

As previously identified, there is a paucity of previous research to add understanding to our findings. One study explored the experience of women in rural communities and perinatal mental health and identified frequent experiences of delays in recognition and access to treatment for perinatal mental health disorders, lack of access to psychological support and lack of continuity of care from services across the perinatal period.[44] This 2015 study also identified themes for women living in rural communities of isolation, stoicism and identifying the importance of chores competing with self-care. Similar to our findings, this study also highlighted the importance of informal care networks.[44] Another study also supported the importance of extended family as critical in rural areas for the care of women with mental health issues in the perinatal period.[44,45]

There have been a number of innovative programs trialled to address the frequent gap in access to specialist perinatal mental health interventions in rural areas, and these include services embedded within the community,[46] within the local delivery of maternity care[47] and online.[48] What is frequently cited as important is services that are acceptable to women and their families, link with local resources and importantly enhanced informal networks of support to reduce isolation.[44,47] In addition to the areas

TABLE 4 Estimates for initial change by region and final adjusted post-partum parenting mixed regression and generalised estimating equation models ($N = 806$)

	Initial change by region model			Final adjusted model		
	b/OR	Robust SE	95% CI	*b*/OR	Robust SE	95% CI
Breastfeeding cessation (OR)						
Intercept (baseline odds)	0.36	0.04	0.29, 0.44	0.46	0.3	0.13, 1.63
Time (follow-up)	7.65***	1.00	5.92, 9.87	8.33***	1.16	6.33, 10.95
Depression	–	–	–	1.04	0.22	0.68, 1.58
MM2-MM3 *c.f.* MM1	0.99	0.18	0.69, 1.41	0.87	0.17	0.59, 1.28
MM4-MM7 *c.f.* MM1	1.40	0.45	0.74, 2.65	0.95	0.33	0.48, 1.86
Perceived parenting stress						
Intercept	34.35	1.08	32.22, 36.48	39.28	6.82	25.91, 52.65
Time (follow-up)	1.99*	0.86	0.31, 3.68	2.44**	1.23	−0.62, 4.21
Depression	–	–	–	8.17***	2.31	3.65, 12.70
MM2-MM3 *c.f.* MM1	2.79	2.00	−1.13, 6.71	4.04*	2.04	0.08, 8.07
MM4-MM7 *c.f.* MM1	2.01	3.71	−5.26, 9.27	1.7	3.56	−5.28, 8.68

Note: All models include the following covariates: ethnicity, maternal age, parity, relationship status, university education and antidepressant use in pregnancy. Time-varying EPDS was also added to the final adjusted parenting stress model. Models include data from 6- and 12-month postpartum only.

Abbreviations: *b*, regression coefficient; MM1, metropolitan areas; MM2-MM3, regional centres and large rural towns; MM4-MM7, medium and small rural towns, and remote and very remote communities; OR, odds ratio; SE, standard error; CI, confidence interval.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

addressed by these programs, our findings suggest that women living rurally may have increased parenting stress. These findings suggest that future support and interventions need to be tailored to not only reducing mental health symptoms but also increasing support for parenting.

In general, the relationship between maternal depression and parenting stress has been identified across a number of studies, but these have drawn predominantly on metropolitan samples.[49] Our findings suggest this is of even greater importance for women living in rural communities, and it is notable that those in more isolated areas found it more difficult to access a range of parent–infant activities although they reported feeling supported by partners and family. Likewise, our findings of a stronger relationship between stressful life events and depression in women living rurally are important to note. This may suggest the future development of targeted perinatal mental health support for these women that includes a focus on parenting and identifies those impacted by stressful events and isolation from supports for parenting. As our study sample was relatively homogeneous, future research exploring these issues should include more culturally and linguistically diverse women, women from first nations and single parents in rural contexts.

There are a number of limitations with this study. We did not include measurement of access to mental health services and interventions and had no measure of the women's perceived isolation. In addition, due to the low numbers in our cohort, only limited analysis was able to be undertaken comparing these women across different rural and remote contexts. Although the common measures used, such as stressful life events scale, State and Trait Anxiety Inventory and the Edinburgh Post-natal Depression Scale, have been validated in Australian pregnant women, this validation has not necessarily included a sample with women from rural communities. The diversity in the sample from an education, marital status and ethnicity perspective was small, and as such, we are unable to comment on how our findings may relate to specific groups of women in rural communities, such as single parents or different ethnic groups. Finally, exercise measured was self-reported recreational exercise, and this tool may miss incidental exercise for women living in rural communities, such working on farms.

5 | CONCLUSION

Our study found that many of the previous findings around perinatal mental well-being in metropolitan samples are similar for rural samples. This included an association between depression and poorer sleep, a decline in exercise and stressful life events. For all women across the perinatal period, we demonstrated declining fruit and vegetable intake, perceived partner support, and similar rates and timing of breastfeeding cessation. However, parenting stress was higher in those outside metropolitan cities, and access to parenting activities and supports was lowest

in those furthest from cities. The findings in our exploratory study suggest further research into perinatal mental health and emotional well-being must include consideration of the impact of rurality. In addition, policy-makers, researchers and service delivery should continue to consider key differences for rural families including within future policies.

Supporting perinatal emotional well-being and mental health is critical for women living rurally, their families and their children. Investment in further research is required to address the current knowledge gaps including understanding how factors associated with women's perinatal mental health and well-being when living in rural communities may be interrelated and what interventions may be helpful. Ensuring models of care are appropriate and tailored for different communities is essential for equitable outcomes. While access to specialist care is critical, this needs to be delivered in a way that is cognisant and tailored to the needs of different communities rather a one size fits all approach.

AUTHOR CONTRIBUTIONS

MG was involved in conceptualization, resources, supervision, project administration, methodology, funding acquisition and writing—original draft. SW was involved in formal analysis, project administration and writing—original draft. MC was involved in conceptualization and writing—review and editing. PW was involved in conceptualization and writing—review and editing. LV was involved in resources and writing—review and editing. PV was involved in resources and writing—review and editing. AL was involved in resources, funding acquisition, supervision and writing—review and editing.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

This project has ethics approval with Mercy Health Human Research Ethics Committee Reference R08/22 and with WA South Metropolitan Health Human Research Ethics Committee Reference 2016-192.

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