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RELATIONSHIP BETWEEN COMPLEMENTARY AND ALTERNATIVE MEDICINE USE AND INCIDENCE OF ADVERSE BIRTH OUTCOMES: AN EXAMINATION OF A NATIONALLY REPRESENTATIVE SAMPLE OF 1,835 AUSTRALIAN WOMEN

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Relationship between complementary and alternative medicine use and incidence of adverse birth outcomes: An examination of a nationally representative sample of 1,835 Australian women

Abstract

Objective: There is evidence of high use of complementary and alternative medicine (CAM) by pregnant women. Despite debate and controversy regarding CAM use in pregnancy there has been little research focus upon the impacts of CAM use on birth outcomes. This paper reports findings outlining the incidence of adverse birth outcomes among women accessing CAM during pregnancy. **Design:** A survey-based cohort sub-study from the nationally-representative Australian Longitudinal Study on Women's Health (ALSWH) was undertaken in 2010. **Participants:** Women (aged 31-36 years) who identified in 2009 as pregnant or recently given birth (n=2445) from the younger cohort (n=8012) of ALSWH were recruited for the study. **Measurements and Findings:** Participants' responses were analysed to examine the relationship between use of CAM and adverse birth outcomes from their most recent pregnancy. Of the respondents (n=1835; 79.2%), there were variations in birth outcomes for the women who used different CAM. Notably, the outcome which was most commonly associated with CAM use was emotional distress. This was found to occur more commonly in women who practised meditation/yoga at home, used flower essences, or consulted with a chiropractor. In contrast, women who consulted with a chiropractor or consumed herbal teas were less likely to report a premature birth, whilst participation in yoga classes was associated with an increased incidence of postpartum/intrapartum haemorrhage. **Key Conclusions:** The results emphasise the necessity for further research evaluating the safety and effectiveness of CAM for pregnant women, with a particular focus on birth outcomes. **Implications for Practice:** Health professionals providing care need to be aware of the potential birth outcomes associated with CAM use during pregnancy to enable the provision of accurate information to women in their care, and to assist in safely supporting women accessing CAM to assist with pregnancy, labour and birth. **Keywords:** pregnancy, labour, birth outcomes, complementary medicine, alternative medicine.

Introduction

Prevention of adverse birth outcomes in modern maternity care

Low maternal mortality rates in high income countries (Betran et al., 2005; Cantwell et al., 2011; Lang and King 2008; Statistics Canada, 2012) have enabled maternity care research and practice to concentrate upon reducing adverse birth events such as post-partum haemorrhage (Kavle et al., 2008; Oyelese and Ananth, 2010; Ribot et al., 2012), infants born small-for-gestational-age (Hack and Fanaroff, 1999), and placental abnormalities (Balat et al., 2003). There is also increasing interest regarding the rates of caesarean sections (Declercq et al., 2011; Kottmel et al., 2012; Macdorman et al., 2008) and other obstetric interventions (Klein, 2011; Parant et al., 2010) and whether these rates are appropriate to the population (Gottvall et al., 2011; Zwelling, 2008). Likewise, dietary recommendations for pregnant women in high-income countries encompass more than fundamental nutritional requirements (Black et al., 2008; Mellor, 2009; Wood and Ronnenberg, 2006) to include broader dietary recommendations (American Dietetic Association, 2008; Bakker et al., 2010), and there have also been calls from maternity care professionals to address women's psychological well-being in addition to attending to physical concerns in maternity care (Lobel et al., 2002; Miller and Larusso, 2011; Tennen and Affleck, 1987).

Complementary and alternative medicine in modern maternity care

It has been identified that women are making an active choice to incorporate complementary and alternative medicine (CAM) - a range of products and treatments not traditionally associated with the medical profession or medical curriculum (Adams et al., 2003; Sibbritt et al., 2005) - within their pregnancy and birth care regimes (Adams, et al. 2011; Adams et al., 2009; Adams et al., 2011; Adams and Tovey 2008; Forster et al., 2006; Steel et al., 2012). The use of CAM within pregnancy is considerable, with prevalence rates reported between 20-60% (Adams et al., 2009), and an emerging body of literature highlights a range of CAM practitioners (Adams et al., 2009; Bishop et al., 2011; Sibbritt et al., 2011; Steel et al., 2012) as contributing to the support of women throughout pregnancy and birth. The reason for this pattern of use has been linked to attempts to minimise obstetric interventions

(Lane, 2008) or to replace lifestyle behaviours discouraged during pregnancy (Furber et al., 2009).

Outcomes of CAM use in pregnancy

A recent Australian study identified two of the most dominant CAM practitioner groups consulted by women for pregnancy-related health conditions were chiropractors (16.3%) and meditation/yoga teachers (13.6%) (Steel et al., 2012). Practitioners from both of these groups make claims of clinical effectiveness and safety of their treatments regarding the provision of care to pregnant women which are based upon their practice philosophy. Chiropractic practitioners propose chiropractic during pregnancy enhances the nervous system function of the mother and that this promotes the health potential for both mother and baby. It is also claimed that by establishing balance through the pelvis via chiropractic manipulation, the birth canal becomes optimised. Proponents of chiropractic for pregnant women argue that women who receive chiropractic treatment during pregnancy should avoid pregnancy complications and labour difficulties (e.g. breech position, intrauterine constraint, dystocia) (Ohm, 2001).

Yoga represents a number of diverse approaches and traditions originating from India but as a whole it is reported to assist individuals to manage their health using a number of therapeutic tools. These include asanas (postures), pranayama (breath work), mudras, relaxation, dietary advice (including vegetarian dietary choices), and lifestyle counselling and self-development guidance (Yoga Australia, 2012). Yoga proponents argue that the mind-body element of yoga surpasses other forms of exercise for pregnant women to bring focus to the woman's breath, energy and self and that this promotes health for the woman (Collins, 1998). Practitioners providing prenatal yoga classes claim women who practise prenatal yoga have a more positive pregnancy and birth experience and are more equipped to cope with the challenges of labour (Swann, 2004). The recommended postures used in prenatal yoga are argued to promote optimum birth positioning and reduce labour pain in early labour (Swann, 2004).

Despite the claims made by CAM practitioners, there is limited clinical evidence for the effectiveness of CAM in pregnancy (Adams et al., 2012; Beddoe et al., 2009;

Drobbin and Welsh, 2009; Ensiyeh and Sakineh, 2009; Furber et al., 2009; Halberstein et al., 2007; Mantle, 1997; Parsons et al., 1999; Phillips and Meyer, 1995; Reis, 2011; Simpson et al., 2001), and non-CAM clinicians have outlined concerns regarding the safety of some CAM use by pregnant women (Adams, 2011; Adams et al., 2011; Gaffney and Smith, 2004). A number of these safety concerns are supported by available research (Borggren, 2007; Bornhoft and Mattheissen, 2012; Borrelli et al., 2005; Dugoua et al., 2008; Mills and Bone, 2005; Narendran et al., 2005; Smith and Cochrane, 2009; Tiran, 1996). Given the prevalence of CAM use by pregnant women, the potential safety issues, and the debate surrounding the integration of these medicines in maternity care, rigorous research identifying potential effects of CAM use on women's birth outcomes is required (Adams, 2011). Unfortunately, previous research has focused primarily upon health conditions associated with pregnancy, and there is very little indication of the impact of the use of CAM in pregnancy on birth outcomes. In response to this important gap, the study presented here provides the first examination of CAM use and birth outcomes drawing upon a large nationally representative sample.

Methods

The study sample was obtained via the Australian Longitudinal Survey on Women's Health (ALSWH). The ALSWH is a longitudinal study of women in three age groups ("young", "mid age" and "older") who were randomly selected from the national Medicare database. Respondents have been shown to be broadly representative of the national population of women in the target age groups (Brown et al. 1999). The present study is based on the 'young' cohort, comprising 8012 women who were aged 31-36 years in 2009. The study sampled a sub-group of women from the 'young cohort' who indicated in the general ALSWH survey for that cohort administered in 2009 (called 'Survey 5') that they were pregnant or had recently given birth (n=2445). These women were invited to participate in the sub-study by completing an additional survey which was administered in 2010. Women were asked to report their use of CAM without identifying the purpose for their use in Survey 5. However, the sub-study survey specifically requested details of CAM use for pregnancy-related health conditions and included a more extensive list of CAMs. This study presents the findings from the analysis of data from both Survey 5 and the additional sub-study

survey. Ethics approval for the sub-study was gained from all institutions involved (see Details of Ethics Approval).

Demographic characteristics

The women were asked about their age, area of residence, number of children, marital status, highest educational qualification attained, health insurance cover and financial situation.

Medical History

The women were asked details of their birth outcomes from previous pregnancies, diagnosed health conditions and health symptoms (both general and pregnancy-related). Women were also asked to provide details of their use of pharmaceutical pain relief in labour for their most recent pregnancy.

Health Care through Pregnancy and Birth

Women were asked to provide details of both the conventional maternity health professionals and CAM practitioners who provided care for pregnancy-related concerns through their most recent pregnancy. They were also asked to identify the CAM products and treatments they used for pregnancy-related issues, and the setting or environment where they gave birth to their youngest child.

Outcome measure

Women were asked to identify whether they experienced any of a range of adverse birth outcomes with the birth of their youngest child.

Statistical Analysis

Comparisons between categorical variables were made using the chi-square test. Bivariate analyses were conducted between each outcome and all of the demographic, health status and health service utilisation variables. Any variables with a bivariate $p < 0.25$ were entered into the respective multivariate logistic regression models, to make adjustment for potential confounding (Hosmer and Lemeshow 2000). For each birth outcome a separate multiple logistic regression model was produced to determine the significant relationships between use of CAM products or treatments and consultations with CAM practitioners, and adverse birth outcomes. All analyses

were conducted using the data analysis and statistical software program Stata 11.1 (Statacorp 2009).

Findings

There were 1835 women who responded to the sub-study survey and were included in the analysis (response rate = 79.2%). The women (see Table 1) had a mean age of 35.0 years (SD=2.30), and most were married (96.3%, n=1760) and had one (38%, n=697) or two (38.2%, n=700) children. A substantial number (62.4%, n=1134) lived in an urban area, and did not have private health cover (71.1%, n=1296). Potential demographic differences between responders and non-responders were investigated and it was found that women with a tertiary education were slightly more likely to have agreed to complete the substudy survey (OR 1.15, CI:1.03-1.29, p=0.010).

The women identified a number of adverse birth outcomes from previous births (Table 2) including vaginal tearing (49.1%), and caesarean section (35.7%). For their most recent pregnancy, the majority of women consulted with a general practitioner (GP) (90.1%), obstetrician (85.2%) and/or a midwife (64.7%) (Table 1). The most prevalent pregnancy-related health conditions (Table 2) were back pain (39.5%), reflux or heartburn (34.7%), and nausea (32.9%). During the birth of their youngest child, most used an epidural for pain relief (51.2%). Events and outcomes associated with the birth of their most previous child include vaginal tearing (29.3%), induction of labour (25.6%), caesarean section before onset of labour (22.3%), episiotomy (11.7%), and infant admittance to special care nursery (11.5%) (Table 3).

The bivariate analyses exploring the consultations with CAM practitioners and use of CAM products and/or treatments for pregnancy-related health conditions, and their relationship with adverse birth outcomes, are presented in Table 4 and 5. Women who consulted with a massage therapist were less likely to have a caesarean section before onset of labour (p=0.02), but more likely to have a caesarean section after labour began (p=0.01). Women attending meditation/yoga classes had a higher incidence of a caesarean section after onset of labour (p=0.005) or an instrumental delivery (p=0.01), but were less likely to have a caesarean section before onset of labour (p<0.001). Women consulting with a naturopath or herbalist were more likely to birth a low birth weight baby (p=0.02). Women were also more likely to experience emotional distress

associated with the birth if they consulted with a chiropractor ($p=0.001$), or attended meditation and/or yoga classes ($p=0.001$).

Those women who consumed herbal teas for pregnancy-related health conditions were less likely to have a premature birth ($p=0.01$) or a caesarean section before onset of labour ($p<0.001$), but were more likely to have medical removal of placenta or blood clots by hand ($p=0.04$) and to have their baby admitted to special care nursery ($p=0.02$). Women who either used flower essences (e.g., Rescue Remedy) or practised meditation or yoga at home were less likely to have a caesarean section before onset of labour (FE: $p=0.001$; Yoga: $p=0.02$), but were more likely to have emotional distress associated with the birth (FE: $p<0.001$; Yoga: $p=0.001$).

Tables 6 and 7 present the multiple logistic regression models for each adverse birth outcome. This analysis controlled for other potential confounding variables which may have influenced the findings of the bivariate analysis and is presented as an odds ratio (OR). After controlling for all significant covariates, it was found that women who consulted with an acupuncturist were less likely to have an episiotomy (OR=0.32, $p=0.02$). Women who consulted with a chiropractor were less likely to have a caesarean section after labour (OR=0.10, $p=0.04$) or premature delivery (OR=0.29, $p=0.04$), but more likely to experience emotional distress (OR=3.28, $p=0.001$) or instrumental delivery (OR=2.13, $p=0.05$). Women who attended yoga/meditation classes were more likely to have excessive blood loss requiring IV infusion (OR=2.96, $p=0.03$). There were no significant associations between any of the birth outcomes and consultations with naturopaths, massage therapists or osteopaths, after controlling for all significant covariates.

There was a positive association noted for women who consumed herbal teas, as their chance of having a premature birth (OR=0.32, $p=0.03$) was lower than those not consuming herbal teas. However, consumption of herbal teas was associated with a higher likelihood of medical removal of placenta/blood clots (OR=2.10, $p=0.02$). Those who used western or Chinese herbal medicines were less likely to have a caesarean section before onset of labour (OR=0.26, $p=0.05$). Women were more likely to experience emotional distress associated with labour or birth if they took flower essences (OR=3.04, $p=0.02$) or practised meditation or yoga at home

(OR=2.40, p=0.02). There were no significant associations between any of the birth outcomes and use of herbal medicines, aromatherapy oils, or homeopathic treatments, after controlling for all significant covariates.

Discussion

Our analysis has identified a number of CAM – chiropractic care, flower essences, and home yoga/meditation practice - are associated with an increased likelihood of experiencing emotional distress with the labour. The causes of psychological distress amongst pregnant women have been identified from previous research as including past adverse life events, limitations on usual coping strategies, past childbirth and pregnancy experiences, and current health complications (Furber et al., 2009). This finding may not represent a causative relationship, but rather reflect attempts by women to ameliorate the distress associated with previous adverse life events or compensate for the absence of their usual coping strategies (e.g., practising yoga to replace alcohol consumption (Furber et al., 2009)). This is supported by the argued benefits of yoga proposed by pregnancy yoga specialists (Collins, 1998) and is also seen in the general population, as women with self-reported depression are more likely to practise yoga and meditation at home (Adams et al., 2012). Current evidence suggests this practice may benefit pregnant women through reduced perceived stress and trait anxiety (Beddoe et al., 2009) and be linked to an increase in optimism and empowerment (Reis, 2011). Although women with a higher level of optimism are more likely to view high-risk pregnancies as controllable and as such have lower distress (Lobel et al., 2002), it has also been proposed that healthy pregnant women who approach birth with a lower perception of their risk (or greater optimism) express greater distress at hospital discharge (Tennen and Affleck, 1987). Furthermore, women who consider their prior risk to be low also undertake strategies to prevent pregnancy-related problems (Tennen and Affleck, 1987). Very limited evidence exists regarding flower essences in any setting, with only preliminary research in the general population finding a reduction in high trait anxiety (Halberstein et al., 2007) (although naturopathic clinical texts recommend its use to manage or treat emotional distress (Mantle, 1997)). This suggests that the women in our study may have been utilising CAM such as chiropractic care, yoga and flower essences for preventing pregnancy and birth complications or interventions, or for attenuating emotional distress.

Our study also indicates that women consulting with chiropractors during pregnancy are less likely to require a caesarean section after onset of labour or to have a premature birth, but more likely to have an instrumental delivery. This finding aligns with claims made by chiropractic maternity care specialists (Ohm, 2001) but is only supported by some low-level research (Drobbin and Welsh, 2009) indicating a benefit of chiropractic through reducing the need for planned c-section delivery for a woman with a breech pregnancy by assisting with cephalic version of the foetus. In contrast, a similarly low-level retrospective case-control study (n=35) of pregnant women found no statistical difference in obstetric interventions for women receiving chiropractic care (Phillips and Meyer, 1995).

Women participating in our study who practised yoga or meditation at home had an increased incidence of post-partum haemorrhage (PPH). This increase may be explained by nutritional insufficiency, as women who practise yoga or meditation regularly are reported to be more likely to have low iron (possibly due to following a vegetarian diet) (Sibbritt et al., 2011); low iron has been strongly associated with increased blood loss at delivery and the immediate postpartum period (Kavle et al., 2008). Despite anaemia being among the controlled covariates in our study, the possibility of non-anaemic low iron levels may explain why the relationship with PPH remained significant in our study after statistical adjustments, particularly given that the recommended screening test used for anaemia in pregnancy is serum haemoglobin (Mellor, 2009), which only identifies end-stage iron deficiency (Wood and Ronnenberg, 2006).

The consumption of herbal teas was associated with a lower incidence of admission of the newborn to special care nursery, but a higher incidence of retained placenta. Although our study does not provide details regarding which herbal teas the women used, previous research has identified ginger (*Zingiber officinale*) and red raspberry leaf (*Rubus idaeus*) (RRL) as the most common herbal medicines used by pregnant women (Forster et al. 2006). Of these two, only RRL is recommended by naturopaths to affect labour and birth outcomes (Wardle and Steel, 2010). Clinical research investigating the outcomes of RRL use during pregnancy is limited, with results suggesting no effect (Parsons et al., 1999; Simpson et al., 2001). Ginger is traditionally used for digestive upset (Bone, 2003) and has been found to have some

clinical effect for pregnancy-related nausea but not vomiting (Borrelli et al., 2005; Ensiyeh and Sakineh, 2009); it has no known adverse effects on pregnancy and birth outcomes (Borrelli et al., 2005).

The absence of any adverse outcomes associated with consultations with naturopaths, massage therapists, or osteopaths, or use of herbal medicines, aromatherapy oils, or homeopathic treatments was also identified in this study. These results suggest that whilst these therapies may not result in a risk to birthing women, they may not convey health benefit either. However, it also may suggest that the intention of treatment was not specifically focused on birth outcomes. Instead, the women using these CAM during pregnancy may have been attempting to manage antenatal complaints such as sleeping problems (Holst et al., 2009), mood disorders (Field et al., 2012), or *striae gravidarum* (Timur Tashan and Kafkasli, 2012). More specific analysis of these individual therapies is needed to better understand these results.

The strengths of our study are the large sample size, high response rate and nationally representative sample of pregnant women. These three features allow the results from our study to be easily generalisable to the broader population of pregnant and birthing women in Australia (Jekel et al., 2007). This is also the first study to provide insights into the use of CAM (and consultation with CAM practitioners) during pregnancy and the outcomes of the associated birth. The interpretation of our findings may be limited by the lack of confirmatory diagnosis for the self-reported medical conditions, symptoms and birth outcomes. The difference in level of education between women who responded to the survey compared with those who did not may also be a limitation, particularly given education has been previously identified as a factor influencing CAM use in pregnant women (Adams et al., 2009). Similarly, the age range of the cohort may limit the generalisability of the findings as age has also been identified as a factor informing CAM use in pregnancy (Adams et al., 2009). The utilisation of CAM and consultation with CAM practitioners is also defined by self-report, so that findings could be affected by recall bias. The smaller numbers in some CAM categories also presents a limitation. Furthermore, the cross-sectional study design limits the ability to draw causal conclusions regarding the relationships between CAM use and birth outcomes. Despite this the ALSWH is a respected source of epidemiological data examining women's health in Australia, and these limitations

are countered by the opportunity provided from conducting the first analysis of CAM product/treatment and practitioner use during pregnancy and their relationship with birth outcomes amongst a large, nationally representative sample of pregnant women.

This is the first study to investigate the relationship between pregnant women's use of CAM and the incidence of adverse birth outcomes in a nationally representative sample. The findings presented in this study add to the current understanding of CAM products and treatments, as well as help to identify new areas requiring further investigation. The adverse birth outcomes associated with CAM use outlined in our results are complex and suggest that uniform approaches to the use of CAM in pregnancy may not be appropriate. However, the findings from our study identify a need for high quality research investigating the safety and effectiveness of a range of CAM used by women during pregnancy, with a particular focus on birth outcomes. Key areas which would benefit from further research attention based upon these study results is the impact of CAM use on emotional distress associated with birth, and the health behaviours associated with yoga practice which may impact on intrapartum/postpartum haemorrhaging. The study does highlight the importance of evaluating CAM individually to determine their risks and merits (both physical and mental) for pregnant women and neonates. Given pregnant women's high rates of CAM use concurrent with conventional maternity care, there is an urgent need for maternity care providers to enquire into its use in this context in order to help ensure safe, positive birth outcomes.

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Table 1: Demographics of participants

Demographics	All participants	
	<i>n</i>	%
Area of residence	1818	100
Urban	1134	62.4
Rural	629	34.6
Remote	55	3.0
Financial status	1826	100
Always difficult to manage on available income	221	12.1
Sometimes difficult to manage on available income	530	29.0
Managing on available income is not too bad	768	42.1
Easy to manage on available income	307	16.8
Number of children	1835	100
None	89	4.9
One	697	38.0
Two	700	38.2
Three or more	349	19.0
Marital status	1827	100
Never married	21	1.2
Married/De facto	1760	96.3
Separated/Divorced/Widowed	46	2.5
Qualifications	1822	100
Year 12 qualification or less	292	16.0
Apprenticeship or Diploma qualification	435	23.9
University degree	669	36.7
Postgraduate university degree	426	23.4
Insurance status	1823	100
Private health insurance	527	28.9
No private health insurance	1296	71.1
Conventional maternity health professionals		
General practitioner	1562/1734	90.1
Midwife	983/1520	64.7
Obstetrician	1416/1662	85.2
Birth environment	1812	100
Public hospital	751	41.5
Private hospital (or private patient at public hospital)	981	54.1

	Birth centre/community	80	4.4
		<i>mean</i>	<i>SD</i>
Age		34.95	2.30

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Table 2: Medical history of participants (n=1835)

Medical History of Participants		
	<i>n</i>	%
Prevalence pregnancy-related health conditions		
Back pain	725	39.5
Reflux or heartburn	637	34.7
Nausea (feeling sick)	604	32.9
Sciatica	406	22.1
Preparing for labour	401	21.9
Hip or pelvic pain	384	20.9
Leg cramps	334	18.2
Constipation	307	16.7
Headaches/migraines	293	16.0
Haemorrhoids	289	15.8
Sleeping problems	279	15.2
Neck pain	228	12.4
Repeated vomiting	201	11.0
Vaginal bleeding	191	10.4
Varicose veins	172	9.4
Fluid retention	160	8.7
Anaemia	136	7.4
Tiredness or fatigue	121	6.6
High blood pressure	121	6.6
Dizziness or fainting	115	6.3
Cravings	116	6.3
Weight management	102	5.6
Urinary tract infection	90	4.9
Gestational diabetes	90	4.9
Pre-eclampsia	58	3.2
Use of pharmaceutical pain relief in labour		
Injection of pethidine or similar painkiller	285/1446	19.7
Epidural	825/1610	51.2
Local anaesthetic to perineum	97/1404	6.9
General anaesthetic	32/1399	2.3
Adverse birth outcomes in previous pregnancies		
Stillbirth (in previous 2 years)	17	0.9
Miscarriage (in previous 2 years)	158	8.6
Termination/ectopic pregnancy (in previous 2 years)	49	2.7
Vaginal tear (requiring stitches)	842/1716	49.1

Caesarean section	619/1733	35.7
Forceps or Ventouse suction	493/1720	28.7
Emotional distress	486/1703	28.5
Episiotomy	452/1710	26.4
Medical removal of placenta and/or blood clots by hand	241/1713	14.1
Premature birth	238/1726	13.8
Excessive blood loss requiring transfusion/saline infusion	183/1717	10.7
Labour lasting more than 36 hours	122/1717	7.1
Low birth weight baby (<2500g)	121/1720	7.0
	<i>mean</i>	<i>SD (min - max)</i>
Diagnosed health condition in the previous 3 yrs*	0.9	1.10 (0 - 19)
Health symptoms in previous 12 months‡	4.5	3.12 (0 - 18)

*Mean number of diagnosed health conditions per woman, defined as diabetes, heart disease, hypertension, anaemia, asthma, bronchitis, depression, anxiety, endometriosis, polycystic ovarian syndrome, urinary tract infection, sexually transmitted infections, cancer, other major illness

‡Mean number of health symptoms per woman, defined as allergies/hayfever/sinusitis, headaches/migraines, severe tiredness, indigestion, breathing difficulties, stiff or painful joints, back pain, problems with one or both feet, urine that burns or stings, leaking urine, constipation, haemorrhoids, other bowel problems, vaginal discharge or irritation, premenstrual tension, irregular periods, heavy periods, severe period pain, skin problems, difficulty sleeping, depression, episodes of intense anxiety, other mental health problems, palpitations.

Table 3: Distribution of Birth Events and Adverse Outcomes (n=1835)

Adverse Birth Outcomes	All Participants	
	n	%
Vaginal tear requiring stitches	538	29.3
Induction of labour	470	25.6
Caesarean section before labour	409	22.3
Episiotomy	215	11.7
Baby admitted to special care nursery	211	11.5
Forceps or Ventouse suction	194	10.6
Caesarean section after onset of labour	184	10.0
Premature birth	145	7.9
Emotional distress	138	7.5
Medical removal of placenta/blood clots by hand	105	5.7
Excessive blood loss requiring IV infusion	103	5.6
Low birth weight baby (<2500g)	76	4.1

Table 4: Bivariate relationship between adverse birth outcomes for current pregnancy and consultations with CAM practitioners for pregnancy-related health conditions

Birth outcomes (n=1835)	CAM practitioners Consultations																	
	Acupuncturist (n=162)		Chiropractor (n=279)		Naturopath/ Herbalist (n=121)		Massage therapist (n=594)		Meditation/Yoga classes (n=230)		Osteopath (n=104)							
	No (%)	Yes (%)	<i>p</i> [*]	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>						
Premature birth	8	7	0.55	8	10	0.19	8	9	0.60	8	8	0.90	8	9	0.62	8	6	0.40
Caesarean section before labour	23	18	0.12	23	22	0.73	23	19	0.35	23	19	0.02	24	13	<0.001	22	22	0.93
Caesarean section after labour	10	14	0.14	10	9	0.56	10	12	0.45	9	13	0.01	10	16	0.005	10	9	0.62
Induction of labour	25	29	0.26	25	27	0.52	25	27	0.62	25	26	0.85	25	25	0.82	26	22	0.43
Episiotomy	12	9	0.19	12	9	0.11	12	12	0.84	11	14	0.04	12	14	0.22	12	7	0.09
Vaginal tear requiring stitches	29	35	0.09	29	32	0.40	29	34	0.29	30	29	0.75	29	34	0.09	29	32	0.60
Forceps or Ventouse suction	10	13	0.32	10	13	0.22	11	12	0.56	10	13	0.03	10	16	0.01	11	7	0.17
Medical removal of placenta/blood clots by hand	6	6	0.98	5	7	0.22	5	7	0.34	5	6	0.62	5	6	0.50	5	7	0.59
Excessive blood loss requiring IV infusion	6	6	0.95	6	6	0.96	6	3	0.26	6	5	0.76	5	7	0.23	6	7	0.65
Low birth weight baby (<2500g)	4	4	0.77	4	6	0.10	4	8	0.02	3	5	0.07	4	4	0.87	4	2	0.24
Emotional distress	7	10	0.15	7	12	0.001	7	10	0.28	7	9	0.09	7	9	0.001	8	7	0.72
Baby admitted to special care nursery	12	9	0.19	11	16	0.01	12	13	0.62	11	13	0.21	12	12	0.99	12	9	0.33

Table 5: Bivariate relationship between adverse birth outcomes for most recent pregnancy and use of CAM products or treatments for pregnancy-related health conditions

Birth outcomes (n=1835)	CAM products/treatments																	
	Herbal medicines (n=170)		Meditation/Yoga at home (n=306)		Aromatherapy oils (n=147)		Herbal teas (n=500)		Flower Essences (n=106)		Homeopathy (n=62)							
	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>			
Premature birth	8	6	0.47	8	6	0.34	9	3	0.04	8	3	0.17	9	5	0.01	8	7	0.62
Caesarean section before onset of labour	22	21	0.68	23	17	0.02	23	14	0.01	23	13	0.07	25	16	<0.001	23	9	0.001
Caesarean section after onset of labour	10	10	0.96	10	11	0.66	10	12	0.51	9	12	0.75	9	12	0.08	10	12	0.46
Induction of labour	2	3	0.70	26	25	0.78	26	25	0.68	26	27	0.54	26	23	0.39	26	24	0.92
Episiotomy	12	11	0.86	12	12	1.0	12	8	1.0	11	14	0.37	11	13	0.09	11	11	0.59
Vaginal tear requiring stitches	29	33	0.34	29	34	0.05	29	34	0.30	12	8	0.46	11	14	0.06	11	13	0.15
Forceps or Ventouse suction	29	33	1.0	10	13	0.12	29	33	0.85	29	33	0.79	28	33	0.31	29	36	0.68
Medical removal of placenta/blood clots by hand	11	11	0.90	5	7	0.16	11	10	0.84	11	10	0.75	10	12	0.04	11	9	0.37
Excessive blood loss requiring IV infusion	6	6	0.35	5	6	0.57	6	5	0.03	6	5	0.05	5	8	0.11	6	4	0.34
Low birth weight baby (<2500g)	5	7	0.47	4	5	0.47	5	9	0.17	6	0	0.69	5	7	0.21	5	7	0.80
Emotional distress	4	5	0.29	6	12	0.001	4	2	0.09	4	3	0.23	5	3	0.49	4	5	<0.001
Baby admitted to special care nursery	7	9	0.61	12	11	0.47	7	11	0.09	7	11	0.89	7	8	0.02	7	16	0.90

Table 6: Multiple logistic regression predicting adverse birth outcomes (compared to no adverse outcomes) for women consulting with CAM practitioners for pregnancy-related health conditions (n=1835)

Birth Outcome	Acupuncturist		Chiropractor		Naturopath		Massage therapist		Yoga classes		Osteopath	
	OR* (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Premature birth	1.09 (0.26-4.61)	0.91	0.29 (0.09-0.94)	0.04 ^b	0.36 (0.07-1.91)	0.23	0.53 (0.22-1.28)	0.16	1.32 (0.39-4.52)	0.66	0.64 (0.12-3.39)	0.60
Caesarean section before onset of labour	2.13 (0.42-10.70)	0.36	0.47 (0.16-1.38)	0.17	3.92 (0.82-18.89)	0.09	0.44 (0.18-1.07)	0.07	0.23 (0.04-1.21)	0.08	1.55 (0.32-7.49)	0.58
Caesarean section after onset of labour	1.58 (0.15-16.66)	0.71	0.10 (0.02-0.55)	0.008 ^b	3.26 (0.50-21.28)	0.22	0.92 (0.29-2.99)	0.90	0.87 (0.15-4.97)	0.88	0.45 (0.06-3.39)	0.45
Induction of labour	1.14 (0.71-1.83)	0.59	0.99 (0.67-1.47)	0.98	1.26 (0.74-2.13)	0.39	0.90 (0.67-1.21)	0.49	0.80 (0.53-1.21)	0.29	0.97 (0.55-1.71)	0.91
Episiotomy	0.32 (0.12-0.85)	0.02 ^a	0.61 (0.31-1.22)	0.16	0.83 (0.33-2.05)	0.68	0.90 (0.54-1.49)	0.68	0.88 (0.45-1.70)	0.70	0.37 (0.11-1.29)	0.12
Vaginal tear requiring stitches	1.21 (0.66-2.22)	0.54	1.13 (0.72-1.78)	0.60	1.11 (0.55-2.23)	0.77	0.99 (0.68-1.42)	0.93	1.20 (0.72-1.99)	0.49	0.70 (0.34-1.42)	0.33
Forceps or Ventouse suction	2.47 (0.82-7.40)	0.11	2.13 (1.01-4.50)	0.05 ^b	0.78 (0.21-2.84)	0.70	1.14 (0.61-2.13)	0.69	1.30 (0.54-3.10)	0.56	0.49 (0.09-2.76)	0.42
Medical removal of placenta/blood clots	0.81 (0.29-2.26)	0.69	1.41 (0.66-3.03)	0.38	0.95 (0.32-2.79)	0.92	1.32 (0.72-2.44)	0.37	1.58 (0.70-3.53)	0.27	0.86 (0.29-2.55)	0.79
Excessive blood loss requiring IV infusion ^c	0.31 (0.03-2.80)	0.29	1.05 (0.30-3.63)	0.94	0.10 (0.01-2.94)	0.18	1.30 (0.51-3.36)	0.58	3.66 (1.17-11.52)	0.03 ^c	2.57 (0.43-15.30)	0.30
Low birth weight baby (<2500g)	1.32 (0.16-10.60)	0.80	0.68 (0.13-3.51)	0.64	4.33 (0.70-26.91)	0.12	3.19 (0.86-11.92)	0.08	2.22 (0.45-10.90)	0.33	0.21 (0.00-22.66)	0.51
Emotional distress ^b	2.01 (0.87-4.67)	0.10	3.27 (1.62-6.62)	0.001 ^b	1.56 (0.55-4.38)	0.40	0.95 (0.52-1.75)	0.87	2.06 (0.94-4.49)	0.07	0.65 (0.18-2.26)	0.50
Baby admitted to special care nursery	0.56 (0.23-1.38)	0.21	1.53 (0.83-2.82)	0.17	0.73 (0.28-1.89)	0.52	0.86 (0.52-1.42)	0.56	1.09 (0.56-2.11)	0.80	1.28 (0.50-3.27)	0.61

*OR = Odds ratio

^a statistically significant association with acupuncture consultation for pregnancy-related health conditions (p<0.05)

^b statistically significant association with chiropractor consultation for pregnancy-related health conditions ($p < 0.05$)

^c statistically significant association with yoga/meditation classes for pregnancy-related health conditions ($p < 0.05$)

The model for each birth outcome also included demographic, health status and health service utilisation variables having a univariate association with the outcome with $p < 0.25$.

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Table 7: Multiple logistic regressions for predicting adverse birth outcomes (compared to no adverse outcomes) for women using CAM products or treatments for pregnancy-related health conditions (n=1835)

Birth Outcome	Herbal medicines		Meditation/Yoga at home		Aromatherapy oils		Homeopathy		Herbal teas		Flower Essences	
	OR* (95% CI)	p	OR (95% CI)	p	OR CI	p	OR CI	p	OR CI	p	OR CI	p
Premature birth	0.71 (0.20-2.56)	0.60	0.50 (0.14-1.75)	0.28	0.21 (0.04-1.14)	0.07	0.11 (0.00-7.83)	0.31	0.32 (0.12-0.87)	0.03 ^c	0.10 (0.01-1.50)	0.10
Caesarean section before onset of labour	0.26 (0.07-0.98)	0.05 ^a	0.58 (0.17-1.96)	0.38	1.73 (0.27-11.07)	0.56	1.16 (0.12-11.39)	0.90	0.71 (0.27-1.82)	0.47	0.32 (0.05-2.21)	0.25
Caesarean section after onset of labour	0.55 (0.10-3.10)	0.50	0.26 (0.04-1.73)	0.17	0.31 (0.02-5.17)	0.42	1.63 (0.13-20.69)	0.71	1.05 (0.28-3.94)	0.94	0.15 (0.02-1.42)	0.10
Induction of labour	0.98 (0.62-1.55)	0.93	0.83 (0.56-1.21)	0.33	1.01 (0.62-1.64)	0.96	1.18 (0.55-2.52)	0.68	0.77 (0.56-1.06)	0.11	0.98 (0.55-1.73)	0.93
Episiotomy	0.55 (0.23-1.30)	0.18	0.77 (0.40-1.49)	0.44	1.00 (0.40-2.53)	1.00	0.49 (0.10-2.36)	0.37	1.17 (0.69-1.98)	0.57	1.09 (0.40-2.98)	0.87
Vaginal tear requiring stitches	1.59 (0.88-2.84)	0.12	1.11 (0.70-1.76)	0.66	0.95 (0.52-1.72)	0.86	1.51 (0.61-3.77)	0.38	1.12 (0.76-1.66)	0.56	1.57 (0.79-3.11)	0.20
Forceps or Ventouse suction	1.27 (0.47-3.42)	0.63	1.82 (0.79-4.22)	0.16	1.86 (0.58-6.01)	0.30	2.19 (0.46-10.36)	0.32	0.90 (0.45-1.80)	0.77	1.49 (0.38-5.82)	0.56
Medical removal of placenta/blood clots by hand ^b	0.74 (0.27-2.05)	0.56	1.73 (0.85-3.54)	0.13	0.83 (0.30-2.32)	0.72	0.81 (0.20-3.29)	0.77	2.10 (1.13-3.90)	0.02 ^c	0.59 (0.16-2.16)	0.43
Excessive blood loss requiring IV infusion	0.76 (0.14-4.01)	0.75	0.84 (0.26-2.65)	0.76	2.66 (0.64-11.12)	0.18	-	-	1.74 (0.65-4.70)	0.27	2.84 (0.47-17.33)	0.26
Low birth weight baby (<2500g)	1.78 (0.30-10.51)	0.52	3.22 (0.74-14.07)	0.12	1.82 (0.19-17.23)	0.60	1.47 (0.06-35.58)	0.81	1.37 (0.37-5.08)	0.64	1.78 (0.13-24.97)	0.67
Emotional distress ^{a,c}	1.67 (0.71-3.94)	0.24	2.40 (1.14-5.07)	0.02 ^b	1.05 (0.41-2.73)	0.92	1.70 (0.47-6.09)	0.42	1.05 (0.55-1.99)	0.89	3.04 (1.20-7.69)	0.02 ^d
Baby admitted to special care nursery ^b	0.66 (0.30-1.49)	0.32	0.74 (0.37-1.47)	0.39	0.98 (0.43-2.26)	0.97	0.33 (0.05-2.36)	0.27	0.58 (0.33-1.02)	0.06	0.91 (0.36-2.50)	0.86

*OR = Odds ratio

^a statistically significant association with using western or chinese herbal medicines for pregnancy-related health conditions (p<0.05)

^b statistically significant association with practising yoga/meditation at home for pregnancy-related health conditions ($p < 0.05$)

^c statistically significant association with using herbal teas for pregnancy-related health conditions ($p < 0.05$)

^d statistically significant association with using flower essences for pregnancy-related health conditions ($p < 0.05$)

The model for each birth outcome also included demographic, health status and health service utilisation variables having a univariate association with the outcome with $p < 0.25$.

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