Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women

Jon Adams PhD, Jane Frawley, Amie Steel, Alex Broom, David Sibbritt

PII: S0266-6138(15)00007-8
DOI: http://dx.doi.org/10.1016/j.midw.2014.12.012
Reference: YMIDW1620

To appear in: Midwifery

Received date: 26 May 2014
Revised date: 1 December 2014
Accepted date: 31 December 2014

Cite this article as: Jon Adams PhD, Jane Frawley, Amie Steel, Alex Broom, David Sibbritt, Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women, Midwifery, http://dx.doi.org/10.1016/j.midw.2014.12.012

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
26 May 2014

Midwifery

Jon Adams

Professor of Public Health

Faculty of Health, University of Technology Sydney, Australia, 2000

jon.adams@uts.edu.au

Dear Debra Bick,

RE: Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women

I would be most grateful if you would consider our manuscript (titled above) for publication in *Midwifery*.

Our paper is the first to identify associations between the use of *both* pharmacological and non-pharmacological labor pain management techniques and maternal and infant birth outcomes while controlling for confounding factors. Analyzing data from a nationally representative sample of 1,835 pregnant women, our study identified women’s use of water for labor pain management as decreasing the likelihood of their baby being admitted to special care nursery while the use of epidural increased this likelihood as well as increased the likelihood of an instrumental delivery. Epidural and pethidine use decreased women’s likelihood of continuing breastfeeding while the use of breathing techniques and massage for pain control increased the likelihood of women continuing breastfeeding.

There remain significant gaps in the evidence base relating to the use of non-pharmacological labor pain control methods and our findings provide a platform with which to develop a broad clinical research program around this topic. We feel that the significance of our findings will be of particularly interest to the international audience of your journal. Please see below for author details, corresponding author and other required information.
1. **RE: Full title of manuscript:**

   Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women

2. **Authors’ names and credentials in the order of authorship for publication:**

   Professor Jon Adams, Professor of Public Health Faculty of Health, UTS, Level 7, Building 10, 235-253 Jones Street, Ultimo NSW 2006 Australia, collected data, prepared manuscript and reviewed manuscript.
   
   Jon.adams@uts.edu.au

   Jane Frawley, Faculty of Health, UTS, Level 7, Building 10, 235-253 Jones Street, Ultimo NSW 2006 Australia, prepared manuscript and reviewed manuscript.
   
   Jane.frawley@uts.edu.au

   Dr. Amie Steel, Faculty of Health, UTS, Level 7, Building 10, 235-253 Jones Street, Ultimo NSW 2006 Australia AND Endeavour College of Natural Health, level 2, 269 Wickham St, Fortitude Valley, Brisbane, QLD 4006 analysed data, prepared manuscript and reviewed manuscript.
   
   Amie.steel@uts.edu.au

   Professor Alex Broom, School of Social Science, Level 3, Michie Building, St Lucia Campus, University of Queensland, St Lucia QLD 4072 collected data, prepared manuscript and reviewed manuscript.
   
   a.broom@uq.edu.au

   Professor David Sibbritt, Professor of Epidemiology at David Sibbritt Faculty of Health, UTS, Level 7, Building 10, 235-253 Jones Street, Ultimo NSW 2006
Australia collected data, prepared tables, prepared manuscript and reviewed manuscript.
david.sibbritt@uts.edu.au

3. The name, mailing address, telephone and fax numbers, and e-mail address of the author to whom communications should be sent (corresponding author)

Professor Jon Adams
Professor of Public Health, Faculty of Health, University of Technology Sydney, Level 7, Building 10, 235-253 Jones Street, Ultimo NSW 2006 Australia.
jon.adams@uts.edu.au
PH: +61 2 9514 7420
Fax: +61 2 9514 1088

4. Conflict of interest disclosure

All authors confirm that they have no conflicts of interest and that this manuscript has not been previously published elsewhere and is not under consideration by another journal. Ethics approval for the study was gained from the relevant ethics committees at the University of Newcastle (#H-2010_0031), University of Queensland (#2010000411) and the University of Technology Sydney (#2011-174N).

5. Acknowledgements

This project is funded by the Australian research Council’s Discovery Project funding (DP1094765).
Jon Adam
Professor of Public Health
Faculty of Health, University of Technology Sydney, Australia, 2000
jon.adams@uts.edu.au
Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women

Abstract

Aim: Women use various labor pain management techniques during birth. The objective of this study is to investigate women’s use of pharmacological and non-pharmacological labor pain management techniques in relation to birth outcomes.

Methods: A sub-survey of a nationally representative sample of pregnant women (n=1,835) from the Australian Longitudinal Study on Women’s Health.

Results: Our analysis identified women’s use of water for labor pain management as decreasing the likelihood of their baby being admitted to special care nursery (OR=0.42, p<0.004) while the use of epidural increased this likelihood (OR=3.38, p<0.001) as well as for instrumental delivery (OR=7.27, p<0.001). Epidural and pethidine use decreased women’s likelihood of continuing breastfeeding (ORs=0.68 and 0.59, respectively, both p<0.01) while the use of breathing techniques and massage for pain control increased the likelihood of women continuing breastfeeding (ORs=1.72 and 1.62, respectively, both p<0.01).

Conclusions: Our study illustrates associations between the use of both pharmacological and non-pharmacological labor pain management techniques and selected birth outcomes while controlling for confounding variables. There remain significant gaps in the evidence base for the use of non-pharmacological labor pain control methods and
our findings provide a platform with which to develop a broad clinical research program around this topic.

**Keywords**

Childbirth; infant health; labor pain; pain management; pregnancy outcome;

**Introduction**

A range of maternal and infant birth outcomes - including vaginal tears, instrumental delivery (forceps/ventouse suction), the admission of the baby to a special care nursery, breastfeeding initiation, and breastfeeding duration amongst others - remain significant issues in high-income countries such as Australia and the US.

Recent Australian data show 30.2% of birthing women experience a vaginal tear that required stitches.\(^1\) Research has identified vaginal tearing may result in short-term and long-term morbidity, such as pain, discomfort, and sexual dysfunction \(^2,\) \(^3\) with 15% of women still experiencing painful intercourse up to three years following initial tearing.\(^2\) Meanwhile, 11.6% of birthing women in Australia have a forceps or vacuum extraction.\(^1\) Forceps deliveries have been identified as associated with stress incontinence, overactive bladder, anal incontinence, and vaginal prolapse, \(^4\) as well as third degree and fourth degree perineal lacerations \(^5,\) \(^6\). Another significant birth outcome is the admission of the baby to special care nursery to receive specialized medical care and treatment not available on the postnatal ward and which may be related to preterm birth including premature rupture of membranes.\(^7\) The admission to a special care nursery occurs with 14.2% of all babies born in Australia.\(^1\) Ninety-two percent of birthing women in Australia initiate breastfeeding of their newborn within the first four days following birth \(^8\) and the percentage of babies fully breastfed decreases significantly over time with approximately 46% of babies remaining fully breastfed at
four months of age. Increased duration of breastfeeding has been identified as holding a number of health benefits for mother, baby, and wider community. 9-13

In Australia, childbirth predominantly takes place in a hospital (96.9%) and most commonly this is a public hospital (69.9% of birthing women) rather than a private hospital (30.1% of birthing women). 1 The management of labor pain is most commonly achieved in high-income countries through the use of pharmacological pain management techniques 1, 14 which aim to relieve the pain of labor 15 and whose use appears to have increased in recent years. 1, 16 In Australia, a substantial number (75%) of women utilize a range of pharmacological pain management techniques during labor, most commonly nitrous oxide (gas) (50.0%), epidural (29.7%), or systemic opioids (e.g. pethidine) (22.0%). 1 A selection of non-pharmacological pain management techniques are also potentially available to women during childbirth which aim to help women cope with pain during labor 15 and include breathing techniques, the use of water (bath, water birth and/or shower), massage, acupuncture/acupressure, transcutaneous electrical nerve stimulation (TENS) machine, and hypnotherapy. Unfortunately, there is a lack of empirical data examining the prevalence of these techniques for pain management.

While identifying quality evidence to support the efficacy of selected pharmacological pain management techniques, a recent Cochrane review also highlights the association of some pharmacological labor pain control methods with a number of adverse effects. 15 For example, research has identified concerns about the ability for infants to suckle in the first two hours after birth following the mother’s use of pethidine 17, 18 and some pilot research suggests pethidine use may negatively affect breastfeeding duration. 19 Previous investigation has also identified an association between a range of adverse outcomes relating to breastfeeding - including a reduction in the effectiveness of breastfeeding within the initial week postpartum, increased incidence of partial or supplemented breastfeeding and an increased likelihood of the mother ceasing breastfeeding earlier - and intrapartum epidural use for labor pain management. 20-22 In contrast, while most non-pharmacological pain management options are non-invasive
and may appear safe for mother and baby their efficacy remains unclear due to a lack of high quality evidence.  

Given the extensive range of labor pain control methods potentially available to women and the many gaps in our current understanding around the implications of their use, this paper draws on a nationally representative sample of women to provide an examination of the relationship between the use of a range of both pharmacological and non-pharmacological pain management techniques and maternal and infant birth outcomes.

**Methods**

**Sample**

The study sample was drawn from the Australian Longitudinal Study on Women’s Health (ALSWH). ALSWH is a longitudinal population-based survey examining the health of over 40,000 Australian women. Women in three age groups (“young” 18-23, “mid-age” 45-50 and “older” 70-75 years) were randomly selected from the national Medicare database, to explore a variety of factors affecting health and wellbeing of women over a 20 year period. Respondents have been shown to be broadly representative of the national population of women in the target age groups. The present study is based on a sub-sample of the “young” cohort, who were aged 31-36 years in 2009 (n=8,012). For the sub-sample 2,445 women who completed the 2009 ALSWH survey (Survey 5) and who identified they were pregnant or had recently given birth were invited to participate in an additional survey administered in 2010. Ethics approval for the sub-study reported here was gained from the relevant ethics committees at the University of Newcastle (#H-2010_0031), University of Queensland (#2010000411) and the University of Technology Sydney (#2011-174N).

**Demographics**
A number of demographics were examined including age, marital status, number of children, highest educational qualification attained, income management, area of residence, and health insurance cover.

**Medical History**

The women were asked to provide details of diagnosed health conditions in the previous three years (e.g. heart disease, bronchitis, depression) and health symptoms (e.g. indigestion, back pain, premenstrual tension) in the previous 12 months. Women were also asked about any pregnancy-related health conditions (e.g. pre-eclampsia, anemia, tiredness) for their most recent pregnancy. The location of the birth was also recorded (i.e. public hospital, private hospital, birthing centre, home, other).

**Pain Management Techniques**

The women were asked to indicate if they used any treatment to relieve pain during labor and/or birth. The list of treatments included both pharmacological (i.e. gas, pethidine and epidural) and non-pharmacological (i.e. breathing techniques, massage, hypnotherapy, TENS machine, bath/birthing pool/shower, acupressure/acupuncture) techniques.

**Birth Outcomes**

Women were asked if they had experienced a range of maternal birth outcomes (vaginal tear requiring stitches, use of forceps/ventouse suction, premature birth, caesarean section before going into labour, caesarean section after labour started, induction of labour, labour lasting more than 36 hours, episiotomy [cutting of vagina], medical removal of placenta, and excessive blood loss requiring extra blood or fluid by
drip) and infant birth outcomes (baby admitted to special care nursery, low birth weight baby, initiation of breastfeeding, and continuation of breastfeeding beyond six weeks).

**Statistical analysis**

Chi-square analyses were used to examine the association between two categorical variables. Bivariate analyses were conducted between each outcome and all of the pain management, demographic and medical history variables. Logistic regression models were used to determine the association between pain management techniques and birth outcomes. Any variables with a bivariate p>0.25 were entered into the respective multivariate logistic regression models, to make adjustment for potential confounding. For each birth outcome a separate multiple logistic regression model was produced to determine the significant relationships. All logistic regression models included potential confounding variables, which were the demographic and medical history measures listed above. All analyses were conducted using statistical program STATA 11.1.

**Findings**

There were 1,835 women who responded to the sub-study survey and were included in the analysis (response rate = 79.2%). The average age of the women was 34.0 years (SD=2.3), most were married (96.3%, n=1,760) and had one (38.0%, n=697) or two (38.2%, n=700) children. A substantial number (62.4%, n=1134) lived in an urban area, did not have private health cover (71.1%, n=1,296), and described their ability to manage on their available income as “impossible/always difficult” (12.1%, n=221), “sometimes difficult” (29.0%, n=530) or “not too bad/easy” (58.9%, n=1,075). In terms of the levels of educational qualifications attained 16.0% (n=292) had high school equivalent or less, 23.9% (n=435) had an apprenticeship or diploma, 36.7% (669) held a university degree, and 23.4% (n=426) held a postgraduate university degree.
Table 1 shows the crude (non-adjusted) distribution of and associations between pain management techniques for birth outcomes for those found to be statistically significant. Women who used breathing techniques were more likely to have a vaginal tear (p<0.001), forceps/ventouse suction (p=0.02), initiate breastfeeding (p=0.008), and continue breastfeeding beyond six weeks (p<0.001), compared to women who did not use breathing techniques. The women who used breathing techniques were also less likely to have their baby admitted to a special care nursery (p<0.001). Women who used massage were more likely to have a vaginal tear (p<0.001), forceps/ventouse suction (p=0.04), initiate breastfeeding (p=0.004), and continue breastfeeding beyond six weeks (p<0.001), compared to women who did not use massage. Women who used bath/birthing pool/shower were more likely to have a vaginal tear (p<0.001) and continue breastfeeding beyond six weeks (p=0.006), compared to women who did not use a bath/birthing pool/shower. The women who used bath/birthing pool/shower were also less likely to have their baby admitted to a special care nursery (p<0.001). Women who used acupressure/acupuncture were more likely to have a vaginal tear (p=0.01), compared to women who did not use acupressure/acupuncture. Women who required gas were more likely to have a vaginal tear (p<0.001) and forceps/ventouse suction (p<0.001), compared to women who did not require gas. The women who required gas were also less likely to have their baby admitted to a special care nursery (p=0.004). Women who used pethidine were more likely to have forceps/ventouse suction (p=0.002) and less likely to continue breastfeeding beyond six weeks (p=0.03), compared to women who did not require pethidine. Women who required an epidural were more likely to have forceps/ventouse suction (p<0.001) and have their baby admitted to a special care nursery (p<0.001), compared to women who did not require an epidural. The women who used epidural were also less likely to have a vaginal tear (p<0.001) and less likely to continue breastfeeding beyond six weeks (p=0.006).

The output from the logistic regression models used to identify the adjusted significant associations between the pain control methods and birth outcomes are presented in Table 2. Women who used breathing techniques were 1.69 (95% CI: 1.13, 2.51) times more likely to have a vaginal tear, compared to women who did not use
breathing techniques \( (p=0.01) \). However, women who required an epidural were 0.45 (95% CI: 0.31, 0.64) times less likely to have a vaginal tear, compared to women who did not require an epidural \( (p<0.001) \). Meanwhile, women who required either pethidine or an epidural were 2.07 (95% CI: 1.09, 3.93) \( (p=0.03) \) and 7.27 (95% CI: 3.93, 13.43) \( (p<0.001) \) times more likely to have forceps/ventouse suction, compared to women who did not require pethidine or an epidural, respectively. Women who used bath/birthing pool/shower were 0.42 (95% CI: 0.24, 0.76) times less likely to have their baby admitted to special care, compared to women who did not use bath/birthing pool/shower \( (p=0.004) \). In contrast, women who required an epidural were 3.38 (95% CI: 1.98, 5.78) times more likely to have their baby admitted to special care, compared to women who did not require an epidural \( (p<0.001) \). Women who used either breathing techniques or massage were 1.72 (95% CI: 1.14, 2.58) \( (p=0.01) \) and 1.62 (95% CI: 1.07, 2.45) times more likely to breastfeed beyond six weeks, compared to women who did not use breathing techniques or massage, respectively. However, women who required either pethidine or an epidural were 0.59 (95% CI: 0.39, 0.88) \( (p=0.01) \) and 0.68 (95% CI: 0.47, 0.97) times less likely to breastfeed beyond six weeks, compared to women who did not require either pethidine or an epidural, respectively. Note that no pain management techniques were statistically significantly associated with the initiation of breastfeeding.

Discussion

This paper, reporting findings from a large, nationally representative sample of pregnant women, is the first study to examine the relationship between a range of both pharmacological and non-pharmacological pain management options and a selection of maternal and infant birth outcomes. Our analysis identifies a number of key findings of practice significance and interest.

First, our analysis identifies women’s use of epidural as increasing the likelihood of experiencing an instrumental delivery and admittance of their newborn to a special care nursery. These findings add to the growing evidence of risk associated with the use of epidural \(^{15}\) and the significance of our finding is further illuminated when considered
alongside the rising rates of epidural use in a number of countries including Australia. 24 Despite adjusting for place of birth, concomitant health conditions, medical history, and maternity care providers, the association between epidural and the increased likelihood of experiencing these negative birth outcomes remains evident and this suggests that the intervention itself (rather than other factors) may possibly contribute to these risks.

Analysis of our data shows that women’s use of water (bath, birthing pool, or shower) for childbirth pain management decreases the likelihood of their baby being admitted to special care nursery. This is a significant finding especially given the recent controversy and debate regarding the role and merits of water birth and that some commentators have outlined concerns for neonatal water aspiration and other infant health concerns following water birth. 25, 26 While a recent Cochrane review suggests there are no negative neonatal outcomes associated with the use of water for labor pain management 15 our analyses identifies a possible health benefit for the newborn baby associated with water use during childbirth. As such, our results highlight the need for further investigation of the potential role of this non-invasive, non-pharmacological technique during labor.

While women’s use of epidural and pethidine for labor pain management did not affect the likelihood of breastfeeding initiation, our study did identify those women who used epidural or pethidine as less likely to continue breastfeeding beyond six weeks. With regards to pethidine use, this finding contrasts with the results of previous research identifying concerns about the ability of infants to suckle in the first two hours after birth following the mother’s use of pethidine for pain management 17, 18: Yet, some past research has tentatively suggested from preliminary data that breastfeeding duration may also be affected by the use of pethidine 19 – a finding to which our analysis appears to provide support. In the case of epidural use and its association with breastfeeding, findings from past research appear to be in line with those from our study. Previous research has identified intrapartum epidural use for childbirth pain management as associated with a range of adverse outcomes around breastfeeding 20-22 including increased incidence of partial or supplemented breastfeeding 22 which is of
particular importance in interpreting our study results given that it is also associated with shorter overall breastfeeding duration. 27

In contrast to the use of epidural or pethidine, those women in our study who employed breathing techniques or massage for childbirth pain control were more likely to continue breastfeeding beyond six weeks and this is an issue that would appear to require further research attention. The benefits of massage use for pain management upon women’s likelihood to maintain breastfeeding duration identified in our study may potentially be associated with an increased level of oxytocin. Investigation beyond maternity care has identified massage as stimulating a parasympathetic nervous system response 28 – a response linked to higher levels of oxytocin and better breastfeeding outcomes following birth. 29 However, current maternity care research only reports the positive effects of breast massage by the neonate during first postnatal breastfeeding on maternal oxytocin levels 30 and the physiological effects of massage use by the mother have not been examined to date and require further investigation in maternity care research. The pertinence for maternity practice and decision-making of our study findings relating to different labor pain management techniques and their association with breastfeeding are highlighted when considered alongside the well-documented health benefits associated with breastfeeding and its duration for the infant 10,12 mother, 9 and wider community. 13

The interpretation of our findings is potentially limited by the fact that birth outcomes and the utilization of pain management techniques were self-reported by the participants and as such our results may be open to the effects of recall bias. More specifically recall bias may have affected the internal validity of the study through the reported prevalence of vaginal tears and episiotomies due to potential confusion between the two terms by some women. Similarly, a discrete definition for ‘breathing techniques’ as a pain management option was not included within the survey and as such any identified association with birth outcomes may be spurious. Beyond the effects of recall bias, the ordering of when the differing pain management techniques were used, alongside the cross-sectional nature of the survey, limits the ability to develop
causal inferences from the findings. In addition, the women in our survey were aged between 32 and 38 and, given the average age of Australian mothers is 30 years old, may represent the older 50% of Australian mothers and may not be representative of younger mothers. However, the ALSWH is a respected source of epidemiological data examining women’s health in Australia, and the limitations of our study are countered by the opportunity to conduct the first analysis of both pharmacological and non-pharmacological pain control methods and their relationship with birth outcomes amongst a large, nationally representative sample of pregnant women.

Our study illustrates associations between the use of both pharmacological and non-pharmacological labor pain management techniques and selected birth outcomes while controlling for confounding variables. There remain significant gaps in the evidence base relating to the use of non-pharmacological labor pain control methods and our findings provide a platform with which to develop a broad clinical research program around this topic. Meanwhile, it is important maternity care providers communicate to women the full range of pain control techniques available as well as the possible adverse effects and benefits of their use for women and their babies.

Disclosure

The authors report no conflict of interest. The results of this manuscript have not been distorted by research funding or conflicts of interest.
References


Table 1: The distribution of pain management techniques amongst birth outcome
<table>
<thead>
<tr>
<th>Pain management techniques</th>
<th>Birth Outcome</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vaginal tear</td>
<td>Forceps / ventouse suction</td>
<td>Special care nursery</td>
<td>Initiated breastfeeding</td>
<td>Continued breastfeeding (&gt;6 weeks)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>p</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Breathing techniques</td>
<td>Yes</td>
<td>39</td>
<td>61</td>
<td>&lt;0.00</td>
<td>13</td>
</tr>
<tr>
<td>(n=1087)</td>
<td>No</td>
<td>15</td>
<td>85</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Massage (n=526)</td>
<td>Yes</td>
<td>39</td>
<td>41</td>
<td>&lt;0.00</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>27</td>
<td>73</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Hypnotherapy</td>
<td>Yes</td>
<td>47</td>
<td>53</td>
<td>0.006</td>
<td>10</td>
</tr>
<tr>
<td>No</td>
<td>TENS machine (n=114)</td>
<td>Bath, birthing pool or shower (n=576)</td>
<td>Acupressure / Acupuncture (n=49)</td>
<td>Gas (n=775)</td>
<td>Pethidine (n=285)</td>
</tr>
<tr>
<td>----</td>
<td>---------------------</td>
<td>--------------------------------------</td>
<td>---------------------------------</td>
<td>------------</td>
<td>----------------</td>
</tr>
<tr>
<td>30</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>70</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>63</td>
<td>61&lt;0.00</td>
<td>61&lt;0.00</td>
<td>61&lt;0.00</td>
<td>61&lt;0.00</td>
</tr>
<tr>
<td>89</td>
<td>0.13</td>
<td>0.18</td>
<td>0.18</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>12</td>
<td>84</td>
<td>8</td>
<td>7</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>88</td>
<td>0.09</td>
<td>0.23</td>
<td>0.23</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>93</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Output from logistic regression models using pain management techniques to predict birth outcomes, adjusted for potential confounding variables including demographic and medical history measures

<table>
<thead>
<tr>
<th>Pain management technique</th>
<th>Forceps / ventouse suction</th>
<th>Baby admitted to special care</th>
<th>Initiated breastfeeding</th>
<th>Continue breastfeeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>p</td>
<td>OR (95% CI)</td>
<td>p</td>
</tr>
<tr>
<td>Vaginal tear</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing techniques (n=1087)</td>
<td>1.69 (1.13-2.51)</td>
<td>0.01</td>
<td>0.96 (0.49-1.89)</td>
<td>0.2</td>
</tr>
<tr>
<td>Massage (n=526)</td>
<td>1.22 (0.88-1.76)</td>
<td>0.2</td>
<td>1.58 (0.91-2.76)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

OR = odds ratio, CI = confidence interval
<table>
<thead>
<tr>
<th>Method</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>IQR</th>
<th>n</th>
<th>Value</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypnotherapy (n=60)</td>
<td>1.87</td>
<td>0.47</td>
<td>1.26</td>
<td>0.50</td>
<td>1.11</td>
<td>0.8</td>
<td>0.30</td>
<td>4.05</td>
</tr>
<tr>
<td>TENS machine (n=114)</td>
<td>0.77</td>
<td>0.41</td>
<td>0.92</td>
<td>0.81</td>
<td>1.14</td>
<td>0.5</td>
<td>0.17</td>
<td>4.68</td>
</tr>
<tr>
<td>Bath, birthing pool or shower</td>
<td>1.25</td>
<td>0.80</td>
<td>0.42</td>
<td>1.04</td>
<td>1.34</td>
<td>0.6</td>
<td>0.38</td>
<td>2.29</td>
</tr>
<tr>
<td>Acupressure / Acupuncture (n=49)</td>
<td>1.34</td>
<td>0.55</td>
<td>0.26</td>
<td>0.79</td>
<td>0.99</td>
<td>0.9</td>
<td>0.08</td>
<td>7.72</td>
</tr>
<tr>
<td>Gas (n=775)</td>
<td>1.32</td>
<td>0.75</td>
<td>0.75</td>
<td>0.80</td>
<td>0.99</td>
<td>0.9</td>
<td>0.13</td>
<td>3.93</td>
</tr>
<tr>
<td>Pethidine (n=285)</td>
<td>0.93</td>
<td>0.65</td>
<td>1.06</td>
<td>0.65</td>
<td>0.59</td>
<td>0.0</td>
<td>0.01</td>
<td>1.94</td>
</tr>
<tr>
<td>Epidural (n=825)</td>
<td>0.45</td>
<td>&lt;0.001</td>
<td>7.27</td>
<td>&lt;0.001</td>
<td>3.38</td>
<td>&lt;0.001</td>
<td>0.61</td>
<td>0.014</td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>(0.31-1.64)</td>
<td>(3.93-13.43)</td>
<td>(1.98-5.78)</td>
<td>(0.32-1.17)</td>
<td>(0.47-0.97)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
26 May 2014

Midwifery

RE: Use of pharmacological and non-pharmacological labor pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1,835 pregnant women

Acknowledgements

The Australian Longitudinal Study on Women's Health, which was conceived and developed by groups of interdisciplinary researchers at the Universities of Newcastle and University of Queensland, is funded by the Australian Department of Health and Ageing. We thank all participants for their valuable contribution to this project. We also thank the NHMRC for funding Professor Jon Adams via an NHMRC Career Development Fellowship as well as the ARC for funding this project via their Discovery Project Funding (DP1094765) and for funding Associate Professor Alex Broom via an ARC Future Fellowship.