Effects of a stability ball exercise programme on low back pain and daily life interference during pregnancy

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ABSTRACT

Background: most pregnant women experience back pain during pregnancy, a serious issue that negatively impacts life quality during pregnancy. Research into an exercise intervention programme targeting low back pain and daily life interference is lacking.

Objective: this study evaluates how a stability ball exercise programme influences low back pain and daily life interference across the second and third pregnancy trimester.

Methods: the study was non-randomised and controlled, examining a target population of low-risk pregnancy women between 20 and 22 weeks of gestation located in a regional hospital in northern Taiwan. All participants had at least minimal low back pain, no prior history of chronic low back pain before pregnancy, and no indications of preterm labour. In total, 89 individuals participated: 45 in the control group and 44 in the experimental group (who attended an antenatal stability ball exercise programme). This programme lasted 12 weeks, composed of at least three sessions per week. Fitness workouts lasted from 25 to 30 minutes. The women completed their basic personal information, the Brief Pain Inventory – Short Form, and the Family Exercise Support Attitude Questionnaire.

Results: after adjusting for demographic data and antenatal exercise status by propensity scores, experimental-group women who participated in the antenatal stability ball exercise programme reported significantly less low back pain and daily life interferences than the control group at 36 weeks of gestation.

Discussion: the inclusion of stability ball exercises during pregnancy may reduce pregnancy low back pain and boost daily life functions. This stability ball exercise programme provides health-care professionals with an evidence-based intervention.

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Introduction

Pregnancy-related low back pain (PR-LBP) is one of the most commonly reported complaints among pregnant women, varying from 50% to 70% based on previous studies (Forrester, 2003; Vermani et al., 2010). In Taiwan, PR-LBP is especially prevalent (75%) (Chang et al., 2011). More than 80% of pregnant women with LBP experience daily discomfort, and consequently struggle with housework, childbearing, and job performance (Wang et al., 2004; Mogren, 2007). In about 30% of women with LBP during pregnancy, this pain adversely impacts life quality, requiring frequent periods of bed rest, and leading to work absences (Sydsjø et al., 1998; Mogren, 2007).

The most common causes of PR-LBP are hormonal, mechanical, and circulation changes, or a combination of the three (Wang et al., 2004; Ho et al., 2009a; Vermani et al., 2010). Hormonal changes cause a laxity within the joints and ligaments in the back and pelvis (Forrester, 2003; Vermani et al., 2010). Meanwhile, postural alterations in balance occur from an increase in uterine volume (Wang et al., 2004; Ho et al., 2009a). Also significant to LBP are the effects of fetus weight on the lumbosacral nerve roots and the reduction in the blood flow due to compression of the great vessels by the gravid uterus (Forrester, 2003; Wang et al., 2004; Vermani et al., 2010).

Ho et al. (2009a, 2009b) summarised previous studies and advised on current low back pain relief strategies including brief rest, low-healed shoes, avoiding certain physical activities, heat application, pain...

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medication, exercises (core muscle strength, water gymnastics, yoga), education and ergonomic advice, acupuncture, massage, relaxation, and chiropractic treatment. Amongst these preventive and therapeutic interventions, exercises may be the most beneficial both to the mother as well as the fetus. Regarding maternal health, benefits include the prevention and treatment of gestational diabetes, the prevention of pre-eclampsia, a decrease in excessive weight gain, a decrease in common physical discomforts associated with pregnancy such as backaches, constipation, bloating, and fatigue (Lokey et al., 1991; American College of Obstetricians and Gynecologists (ACOG), 2003; Dempsey et al., 2005). In addition, exercise during pregnancy has psychological benefits, such as improved self-esteem, mental stability, and decreases in depression symptoms (American College of Obstetricians and Gynecologists (ACOG), 2003; Poudveigne and O’Connor, 2005).

Concerning the fetus health, Juhl et al. (2008) indicated that exercise during pregnancy actually reduces the risk of complications. They analysed data of over 85,000 births in Denmark to examine the relation between physical exercise during pregnancy and the risk of preterm birth. Results indicated a reduced risk of preterm births among the almost 40% of women who engaged in some kind of exercise during pregnancy compared to non-exercisers (hazard ratio = 0.82, 95% confidence interval: 0.76, 0.88).

According to the centre of gravity theory, which posits that during pregnancy the centre of gravity moves forward and thus requiring strong core muscles to maintain the stability of lumbar spine and the pelvic girdle (Borg-Stein and Dugan, 2007). Previous studies have shown that strengthening the body's core muscles during pregnancy reduces the chance of back injury (Petrosky et al., 2005, 2008) and diminishes back pain (Dumas et al., 1995). Because these muscle groups stabilise the trunk, core strength enhances the body’s balance. Traditionally, this has been accomplished through relatively stable benches and floors or, more recently, via the incorporation of more unstable platforms, e.g. Swiss Balls, which are effective due to their inherent instability. Unstable training environments reportedly enhance training effects through increased activation of stabilisers and core muscles, in turn improving neuromuscular co-ordination. Vera-Garcia et al. (2000) compared the abdominal muscle response during curl-ups on both stable and labile surfaces in eight men with good health and no history of LBP. Performing curl-ups on labile surfaces was shown to have much higher amplitude of abdominal muscle activity than stable bench exercises. The authors suggest a much higher demand on the motor control system, which may be desirable for LBP treatment. Previous studies also confirm evidence of the role of stabilisation exercises in LBP. Marshall and Murphy (2006) evaluated 20 patients with LBP over the course of a 12-week rehabilitation programme using the Swiss ball. They found this modality of exercise may successfully improve the functional capacity of patients with chronic non-specific LBP, attributing the reduction in disability to the improvement of the flexion relaxation response of the erector spinae. Shen et al. (2009) investigated the biomechanical impact of Swiss ball training on the stability of lumbar vertebra in patients with intervertebral disc herniation. After four weeks of Swiss ball training, researchers assessed pain, abdominal and back muscle strength, with lumbar traction compared to a control group that only utilised lumbar traction. Among the experiment group, they found that abdominal and back strength increased significantly and pain level decreased significantly, concluding that the stability of the lumbar vertebra increased significantly with the use of Swiss ball and lumbar traction exercises.

Previous studies have suggested that many factors may decrease muscle strength, which accounts for LBP. These factors included age (Owino et al., 2001), parity (Mogren and Pohjanen, 2005; Albert et al., 2006), body mass index (Mogren and Pohjanen, 2005), occupational status (Mogren and Pohjanen, 2005; Chang et al., 2012) and habitual exercise (Ostgaard et al., 1994). Educational level (Chang et al., 2012) and social support (van Dijk et al., 2006) were associated with pain and pain interference. These findings may be due to the possibility that people with lower educational levels may have less self-care knowledge. Moreover, those with higher social support may have access to a higher level of personal assistance that reduces the need to perform daily activities, in turn reducing their pain interference perceptions (Chang et al., 2012). Perceived social support has also been described as a significant factor associated with exercise behaviour (Resnick et al., 2002). Social support related to exercise behaviour may be instrumental, informational, emotional, or appraisal. These different types of support suggest that social influences may have a direct effect on exercise behaviour (Albright et al., 2005; Thornton et al., 2006).

In sum, factors previously identified in the literature as associated with LBP and exercise behaviour include: age, parity, education, body mass index, occupational status, habitual exercise, and social support. Using this research as a foundation to adjust for confounding variables, this study evaluated how stability ball exercise programme influence low back pain and daily life interference across the second and third pregnancy trimester.

Methods

Design

This was a non-randomised controlled experimental study, with data collected from January to December 2010. In reverence to Chinese culture and tradition, some participants may have been discouraged from exercising during pregnancy due to concerns of interfering with ‘Tai-Shen’ or ‘Tai-Qi’ (spirit of fetus), an undesirable outcome that is believed to lead to spontaneous abortion or preterm labour (Sung, 1996). For this reason, participants were permitted to select their preferred group.

Study participants

Female inclusion criteria were as follows: (1) primigravida at 22–24 weeks of gestation, (2) age ≥21 years, (3) no major obstetric or medical pregnancy complications based on antenatal charting, (4) singleton pregnancy, (5) at least minimal LBP present, (6) normal extremities and capable of regular physical activity, and (7) able to listen, speak, read and write in Chinese. Participants with chronic LBP associated with sciatica before pregnancy, or any signs of preterm labour were excluded.

A statistical power analysis was used to calculate the required sample size, \( n = 41 \), and effective size 0.3 were assumed. On the basis of G*Power (Germany; version 3.1.1, Faul et al., 2007), a one-tailed test and an effect size value detected the changes in pain level between groups. The sample size was determined to be optimal at 41 participants per group. The authors permitted an attrition rate of 20%. The suggested attrition rate was estimated from previous longitudinal studies ranging from 8.0 to 27.4% (To and Wong, 2003; Mogren, 2007; Chang, 2011).

Initially, the principle investigator (PI) contacted 375 pregnant women, of which 102 participants were recruited: 51 in the experimental group and 51 in the control (Fig. 1). However, some participants (n=13) withdrew for the following reasons: (1) unable to be contacted (n=3), (2) preterm labour (n=5), (3) bleeding (n=1), and (4) frequent uterine contractions (n=4). Six participants from the experimental group and seven participants from the control group were removed from the original sample number,
a 12.8% loss. The final study group included 45 participants in the experimental group and 44 participants in the control group.

Setting
Women were recruited from the antenatal educational classes in a large urban hospital in northern Taiwan. At this hospital, all women received standard obstetric care, including 10–12 regular physical check-ups and one-to-one antenatal care. Depending on the gestation level of the participant woman, nursing staff offered one-to-one antenatal care during their antenatal check-ups, including pregnancy-related discomfort management, weight control, nutrition, exercise, breast-feeding skills, childbirth preparation, and parenting skills. The hospital also offered four-sessions of antenatal educational classes monthly. The topics were repeated monthly and taught by four antenatal educators, covering topics related to healthy behaviour, signs and stages of labour, comfort measures during labour, medical interventions, postpartum recovery, breast feeding and baby care. The programmes are open to pregnant women and their support people.

Antenatal stability ball exercises programme
The antenatal stability ball programmes comprised a one-page exercise protocol and 32-minute videotape programme. The programme was designed by a fitness specialist who held a Masters degree in exercise science and was a certified fitness and aerobics instructor. This individual spent 15 years teaching stability ball exercises, and had worked as an instructor at a northern Taiwanese university. In total, the training programme featured 14 stabilisation exercises that focused on transversely-oriented abdominals, the lumbar multifidus, and pelvic floor muscles (Table 1). Prior to the study, the primary investigator (PI) took a fitness course and seminars related to stability exercises. The PI practised the exercises under the supervision of the exercise programme designer.

We provided three different ball sizes to the participants, 55, 65, and 75 cm in diameter. The appropriate size of ball is determined by the participant’s height (Carriere, 1998; Perez, 2000). In order to maintain balance exercises, the woman has the mobility to maintain a neutral spine easily when sitting with hips and knees at an angle of approximately 90° (Carriere, 1998). The ball must be firmly inflated, and keep sharp objects away from the ball. All balls have passed the security check, which can bear at least 200 kg weight.

In a formal study, the PI provided individual guidance twice a week. All members of the experimental group were requested to attend stability ball exercise class at least once a week and practise at home 25–30 minutes two times a week for a period of 12 weeks. To ensure research protocol compliance, a weekly training diary was maintained during the training period. The PI also personally called all participants to ensure their active involvement in the study.

Measurements
The following demographic information was collected: age, education, occupation, height, weight (pre-pregnancy weight, gestational body weight, and body weight gains), pre-pregnancy body mass index (BMI), and pre-pregnancy exercise behaviour.

The Brief Pain Inventory–Short Form Taiwanese Version
Pregnancy-related low back pain was measured by the Brief Pain Inventory–Short Form Taiwanese Version (BPI-T) (Ger et al., 1999). BPI-T is a patient-based assessment tool comprising two parts. The first consists of 4 items: pain location, pain severity, analgesics used, and pain relief. It evaluates worst, average, and current pain intensity on a scale of 0–10, with ‘no pain’ and ‘worst possible pain’ serving as descriptive anchors. For the second, the patient is asked seven categories concerning pain interference in daily life, including: general activity, mood, walking ability, normal work, relations with others, sleep, and enjoyment of life. These categories are scored on a scale of 0–10 (0=no interference and 10=complete interference). The questionnaire’s reliability and validity was confirmed in patients with rheumatoid arthritis, chronic low back pain, and HIV/AIDS (Cleeland and Ryan, 1994; Harris et al., 2006; Leppert and Majkowicz, 2010). Studies into the psychometric properties of the BPI-T have indicated that the instrument is relatively independent of cultural and linguistic bias (Cleeland and Ryan, 1994; Harris et al., 2006; Leppert and Majkowicz, 2010). The Taiwan version also exhibits strong psychometric properties, including excellent internal consistent internal consistency, test–retest reliability, and construct validity (Ger et al., 1999). In this study, Cronbach’s alpha coefficient for the pain severity and pain interference during the four data collecting times ranged from 0.86 to 0.91.

The Family Exercise Support Attitude Questionnaire
After reviewing the literature, investigators developed the Family Exercise Support Attitude Questionnaire (FESAQ) (Ho, 2004; Dishman et al., 2010) and in consultation with four experts on physical therapy, recreational sports and health promotion, and obstetrics nursing. The value of CVI was 1.00. The questionnaire included three dimensions of exercise support: informational, emotional, and instrumental support from family members. Each item was scored on a five-point scale. In total, this questionnaire included seven items where total scores ranged from 7 to 35. A higher score indicated a higher perception of family exercise support. Cronbach’s α coefficient was 0.86.
Table 1

Stability ball exercise protocol.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Main muscles</th>
<th>Purpose</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated on the stability ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pelvic circling and rocking</td>
<td>Lumbar, hip joints, and core muscles</td>
<td>Exercise lumbar muscles and hip joints; relax pelvic floor muscles;</td>
<td>6–8 times</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and reduce LBP</td>
<td>for each</td>
</tr>
<tr>
<td>2. Forward abdominal and pelvic muscle</td>
<td>Pelvic floor muscles</td>
<td>Awaken the proprioception of pelvic floor muscles.</td>
<td>8 times</td>
</tr>
<tr>
<td>exercises</td>
<td></td>
<td></td>
<td>while</td>
</tr>
<tr>
<td></td>
<td></td>
<td>maintain a steady contraction for 5 seconds, holding each</td>
<td>maintaining</td>
</tr>
</tbody>
</table>
demographic and obstetric variables \((Z_i)\); for example, \(W_i = 1/Pr\left[X_i = x_i | Z_i = z_i\right]\). The generalised estimating equations (GEE) model controlled the effect of study covariates and analysed the independent effect of stability ball exercises. The level of significance was set at 0.05, one tailed.

**Findings**

Among the 89 trial participants, the average age was 30.44 (SD = 3.32) years. Most had graduated from university \((n = 40, 44.9\%)\). Their heights ranged from 147–170 cm \((mean = 159.37; SD = 5.16)\). The average pre-pregnancy weight and BMI were 54.68 kg \((SD = 9.03)\) and 21.53 \((SD = 3.4)\), respectively. The average total pregnancy weight gain was 14.75 kg \((SD = 3.4)\). The groups displayed no statistical differences in demographic and obstetrical variables \((p > 0.05)\) \(\text{(Table 2)}\).

The effect of stability ball exercises on LBP and daily life function interference \((DLFI)\) was measured using the BPI-SF. At baseline \((22\rightarrow 24\) gestational weeks), the mean LBP score for the intervention group was 4.04 \((SD = 3.55)\) compared with 5.18 \((SD = 3.67)\) for the control group. On the 28th, 32th, and 36th gestational weeks, mean LBP scores for the experimental group had risen slightly, whereas the control group had risen significantly \(\text{(Table 3 and Fig. 2)}\). GEEs evaluated the differences after adjusting for several variables with potential effects on LBP. Table 4 shows how changes for mean LBP were significantly lower in the intervention group \((\beta = −2.65, p < 0.01)\) than the control. Time-dependent changes also indicate that post-test LBP values rose an average 4.30–8.59 points over pretest results, implying a growth effect. However, the interaction effect \((\text{group difference and time})\) revealed that the intervention group achieved a significantly greater drop in LBP values compared to their control group peers over time \((\beta = −2.37–7.07, p < 0.01)\).

The same pattern was found in the daily life function interference \((DLFI)\). At baseline \((22\rightarrow 24\) gestational weeks), the mean DLFI score for the experimental group was 17.73 \((SD = 11.99)\) compared to 24.25 \((SD = 12.30)\) for the control group. On the 28th, 32nd, and 36th gestational weeks, mean DLFI scores for the experimental group had fallen slightly, whereas the control group had risen significantly \(\text{(Table 3 and Fig. 2)}\). GEEs evaluated differences after adjusting for several variables with potential effects on DLFI. Table 4 shows how changes for mean DLFI were significantly lower in the intervention group \((\beta = −4.63, p < 0.05)\) than the control. Time-dependent changes also indicate that post-test DLFI values rose an average 6.58–11.72 points over pretest results, implying a growth effect. However, the interaction effect \((\text{group difference and time})\) revealed that subjects in the intervention group achieved a significantly greater drop in DLFI values compared to their control group peers over time \((\beta = −12.69–20.32, p < 0.001)\).

**Discussion**

Low back pain \((LBP)\) is one of the most common complaints in antenatal care. In this cohort, we observed an incidence of 76.8% at 20–22 weeks of gestational age \((\text{no LBP} = 87/375, \text{Fig. 1})\). These high proportions of LBP complaints conform to those of previous studies \((\text{Wang et al., 2004; Ansari et al., 2010})\). As expected, as pregnancy progressed, a significant positive linear trend in the LBP and body weight was observed \((\text{Tables 2 and 3})\). Ho \((2008)\) indicated that pregnancy is associated with increased trunk mass, which may lead to postural alterations. Such changes related to the

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**Table 2** Participant background, exercise information, and family exercise support attitude.

<table>
<thead>
<tr>
<th>Overall ((N = 89))</th>
<th>Control group ((n = 44))</th>
<th>Intervention group ((n = 45))</th>
<th>Statistics</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (M, SD)</strong></td>
<td>30.44 3.32</td>
<td>29.77 3.58</td>
<td>31.09 2.95</td>
<td>–1.90* 0.061</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td>7.17* 0.067</td>
</tr>
<tr>
<td>High school</td>
<td>18 20.2</td>
<td>13 29.5</td>
<td>5 11.1</td>
<td></td>
</tr>
<tr>
<td>Junior College</td>
<td>21 23.6</td>
<td>12 27.3</td>
<td>9 20.0</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>40 44.9</td>
<td>16 36.4</td>
<td>24 53.3</td>
<td></td>
</tr>
<tr>
<td>Masters and above</td>
<td>10 11.2</td>
<td>3 6.8</td>
<td>7 15.6</td>
<td></td>
</tr>
<tr>
<td><strong>Height (cm, M, SD)</strong></td>
<td>159.37 5.16</td>
<td>158.76 4.58</td>
<td>159.97 5.67</td>
<td>–1.10* 0.273</td>
</tr>
<tr>
<td><strong>Weight (kg, M, SD)</strong></td>
<td>54.68 9.03</td>
<td>54.27 9.20</td>
<td>55.09 8.97</td>
<td>–0.42* 0.673</td>
</tr>
<tr>
<td>Pre-pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational weeks 20–22</td>
<td>57.73 9.54</td>
<td>57.05 9.93</td>
<td>58.40 9.20</td>
<td>–0.66* 0.508</td>
</tr>
<tr>
<td>Gestational weeks 24</td>
<td>59.97 9.76</td>
<td>59.24 10.11</td>
<td>60.68 9.47</td>
<td>–0.70* 0.487</td>
</tr>
<tr>
<td>Gestational weeks 28</td>
<td>62.29 9.90</td>
<td>61.54 10.13</td>
<td>63.02 9.73</td>
<td>–0.71* 0.485</td>
</tr>
<tr>
<td>Gestational weeks 32</td>
<td>64.70 9.95</td>
<td>64.21 10.29</td>
<td>65.21 9.68</td>
<td>–0.46* 0.647</td>
</tr>
<tr>
<td>Gestational weeks 36</td>
<td>67.07 9.95</td>
<td>66.92 10.25</td>
<td>67.25 9.73</td>
<td>–0.15* 0.889</td>
</tr>
<tr>
<td>Gestational weeks 40</td>
<td>69.45 10.17</td>
<td>69.68 10.46</td>
<td>69.20 9.95</td>
<td>0.21* 0.832</td>
</tr>
<tr>
<td>Total weight gain</td>
<td>14.75 3.40</td>
<td>15.40 3.61</td>
<td>13.99 3.01</td>
<td>1.91* 0.059</td>
</tr>
<tr>
<td>Pre-pregnancy BMI (M, SD)</td>
<td>21.53 3.40</td>
<td>21.50 3.36</td>
<td>21.55 3.47</td>
<td>–0.07* 0.945</td>
</tr>
<tr>
<td><strong>Regular physical activity status (Yes, %)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-pregnancy</td>
<td>34 38.2</td>
<td>16 36.4</td>
<td>18 40.0</td>
<td>0.13* 0.724</td>
</tr>
<tr>
<td>Gestational weeks 22–24 (baseline)</td>
<td>19 20.9</td>
<td>7 15.9</td>
<td>12 25.5</td>
<td>1.27* 0.259</td>
</tr>
<tr>
<td>Gestational weeks 26–28</td>
<td>55 61.8</td>
<td>11 25.0</td>
<td>44 97.8</td>
<td>49.91&lt; 0.001</td>
</tr>
<tr>
<td>Gestational weeks 30–32</td>
<td>51 57.3</td>
<td>12 27.3</td>
<td>39 86.7</td>
<td>32.08&lt; 0.001</td>
</tr>
<tr>
<td>Gestational weeks 34–36</td>
<td>48 53.9</td>
<td>10 22.7</td>
<td>38 84.4</td>
<td>34.11&lt; 0.001</td>
</tr>
<tr>
<td>Family exercise support attitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (22–24 weeks)</td>
<td>16.67 7.00</td>
<td>13.82 5.49</td>
<td>19.47 7.24</td>
<td>–4.15* 0.001</td>
</tr>
<tr>
<td>Gestational weeks 26–28</td>
<td>17.00 7.08</td>
<td>12.98 5.53</td>
<td>21.02 6.14</td>
<td>–6.46* 0.001</td>
</tr>
<tr>
<td>Gestational weeks 30–32</td>
<td>17.78 7.95</td>
<td>12.93 5.87</td>
<td>22.95 6.52</td>
<td>–7.44* 0.001</td>
</tr>
<tr>
<td>Gestational weeks 34–36</td>
<td>18.45 8.36</td>
<td>12.80 5.22</td>
<td>25.00 6.26</td>
<td>–9.50* 0.001</td>
</tr>
</tbody>
</table>

*Independent t-test.  
†χ² test.  
‡Accumulating 30 minutes or more of moderate intensity exercise on most days of the week.
BMI, pre-pregnancy exercise status, and family exercise support attitude by
is safe and bene-

These results were consistent with previous studies, suggesting that
attitude scores and was more active overall than the control group.
attitude and Hausenblas, 2007; Yeo, 2010). The American College of
attitude and Hausenblas, 2007; Yeo, 2010). The American College of
obstetricians and Gynecologists (ACOG) (2002) has advised preg-
dant women without medical or obstetric complications to engage
in regular physical activity. Their target exercise regimen is 30
minutes or more of moderate daily exercise on most, if not all,
days of the week (American College of Obstetricians and
Gynecologists (ACOG), 2002; Zavorsky and Longo, 2011). However,
during the subject recruitment phase, 85 of the 375 pregnant
women (22.67%, Fig. 1) refused participation due to exercise
taboos. Moreover, a large proportion of our sample group who
had conducted regular weekly exercises prior to pregnancy
reported no physical activity nor had substantially reduced their
exercise levels following pregnancy. Table 2 shows that our study
had a higher proportion of sedentary subjects (74.5
for the
control group) compared to previous studies reporting a sample of
60% inactive pregnant women (Hausenblas and Downs, 2004;
Marquez et al., 2009).

There were three potential rationales to explain these findings.
First, in Chinese culture, habitual weekly exercise during pregnancy
has been discouraged due to concerns about ‘Tai-Shen’ or ‘Tai-Qi’
(fetus spirit), leading to suboptimal fetal and maternal outcomes
(Sung, 1996). Second, Taiwan is characterised by a low birth rate,
which means that pregnant women are often highly appreciated and
protected (Chang, 2011). In addition, Chinese culture emphasises
care-taking of pregnant women. Such factors adversely impact
exercise behaviours among the sampled pregnant women (Chang,
2011). Third, besides these cultural aspects, social support for exercise
also influenced participants’ motivations and beliefs about the need
to perform physical activities and/or exercises. Our study found that
the experiment group had more positive family exercise support
attitude scores and was more active overall than the control group.
These results were consistent with previous studies, suggesting that
social support is a main psychological and physical-health determi-
nant (Albright et al., 2005; Thornton et al., 2006). Albright et al.

![Fig. 2. Changes in low back pain and daily life function interference during baseline (22–24 weeks) and posttests.]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall mean (SD)</th>
<th>Experimental group mean (SD)</th>
<th>Control Group mean (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low back pain</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (22–24 weeks)</td>
<td>8.63 (4.47)</td>
<td>7.67 (4.68)</td>
<td>9.61 (4.07)</td>
<td>−1.486</td>
<td>0.141</td>
</tr>
<tr>
<td>28 weeks</td>
<td>11.51 (4.66)</td>
<td>9.11 (4.04)</td>
<td>13.91 (3.98)</td>
<td>−5.611</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>32 weeks</td>
<td>12.55 (6.38)</td>
<td>8.12 (4.43)</td>
<td>16.68 (5.00)</td>
<td>−8.330</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>36 weeks</td>
<td>13.77 (6.31)</td>
<td>8.63 (4.86)</td>
<td>18.20 (3.35)</td>
<td>−10.50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Daily life interference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (22–24 weeks)</td>
<td>20.96 (12.51)</td>
<td>17.73 (11.99)</td>
<td>24.25 (12.30)</td>
<td>−2.532</td>
<td>0.013</td>
</tr>
<tr>
<td>28 weeks</td>
<td>24.16 (15.74)</td>
<td>12.25 (8.99)</td>
<td>36.07 (11.40)</td>
<td>−10.884</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>32 weeks</td>
<td>27.13 (18.20)</td>
<td>11.00 (8.96)</td>
<td>42.16 (9.67)</td>
<td>−15.383</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>36 weeks</td>
<td>29.50 (20.78)</td>
<td>9.79 (9.56)</td>
<td>46.52 (9.74)</td>
<td>−17.178</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3
Differences in low back pain and daily life interference between the two sample groups (N=89).

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>SE</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td><strong>Low back pain</strong></td>
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<td></td>
</tr>
<tr>
<td>Group (experimental versus control)</td>
<td>−2.65</td>
<td>0.98</td>
<td>0.007</td>
</tr>
<tr>
<td>Time (gestational weeks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (22–24 weeks)</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 weeks</td>
<td>4.30</td>
<td>0.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>32 weeks</td>
<td>7.07</td>
<td>0.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>36 weeks</td>
<td>8.59</td>
<td>0.58</td>
<td>&lt;0.001</td>
</tr>
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<td>Group × time</td>
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<tr>
<td>Group × baseline (22–24 weeks)</td>
<td>−2.37</td>
<td>0.88</td>
<td>0.007</td>
</tr>
<tr>
<td>Group × 28 weeks</td>
<td>−5.96</td>
<td>1.22</td>
<td>&lt;0.001</td>
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<tr>
<td>Group × 32 weeks</td>
<td>−7.07</td>
<td>1.02</td>
<td>&lt;0.001</td>
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<tr>
<td><strong>Daily life interference</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Group (experimental versus control)</td>
<td>−4.63</td>
<td>1.96</td>
<td>0.016</td>
</tr>
<tr>
<td>Time (gestational weeks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (22–24 weeks)</td>
<td>Reference</td>
<td></td>
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<tr>
<td>28 weeks</td>
<td>6.58</td>
<td>2.06</td>
<td>0.001</td>
</tr>
<tr>
<td>32 weeks</td>
<td>9.23</td>
<td>2.07</td>
<td>&lt;0.001</td>
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<tr>
<td>36 weeks</td>
<td>11.72</td>
<td>2.83</td>
<td>&lt;0.001</td>
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<tr>
<td>Group × time</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Group × baseline (22–24 weeks)</td>
<td>−12.69</td>
<td>2.25</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group × 28 weeks</td>
<td>−15.77</td>
<td>2.50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group × 36 weeks</td>
<td>−20.32</td>
<td>2.94</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 4

shifting of the centre of gravity have been postulated as one of the
major causes of LBP during pregnancy.

Previous studies have indicated that exercise during pregnancy
is safe and beneficial to both mother and fetus (Berk, 2004; Downs
and Hausenblas, 2007; Yeo, 2010). The American College of
Obstetricians and Gynecologists (ACOG) (2002) has advised preg-
ant (Albright et al., 2005; Thornton et al., 2006). Albright et al.
Culturally-relevant intervention strategies should focus on family health in an effort to revise entrenched beliefs and promote individual exercise habits during pregnancy. Third, based upon the effectiveness of this stability ball exercise programme to LBP, the health-care professionals may introduce it into postnatal classes to encourage the continuation of the exercises. Future studies may investigate the effectiveness of the programme to postnatal period in terms of LBP, stress urinary incontinence, and weight loss.

Several limitations were inherent to this study. Firstly, due to cultural and ethical issues, the non-randomised group assignment should experience an internal validity of the interpretations. The participants’ self-selection of group assignment may be a confounding variable that contributed to a bias. While no group differences were identified among demographics, obstetrics, or pre-pregnancy exercise status, this small sample size does not assure that group differences are indeed irrelevant. In response, a propensity score analysis was used to adjust the inequality of the participants’ underlying exercise pattern. Secondly, because a primary investigator conducted the interventions and data collection, observer bias was unavoidable. The participants in the intervention group may have answered questions in a manner geared towards approval seeking or receiving the favour of the researchers. Thirdly, due to time limitations, neonatal birth outcomes went unobserved; therefore, we suggest further investigation into the pregnancy effects, if any, of our exercise programme, e.g. gestational weeks, birth weight, and Apgar scores. Lastly, since the study was conducted in a regional hospital in northern Taiwan with nullipara women, caution should be taken in generalising findings to other settings and multiparous women.

Conflict of interest

None declared.

Ethical approval

IRB approved by National Taipei College of Nursing #NCTNNM-9801.

Acknowledgement

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Sung, J.S., 1996. The fetal sedative and the perception of ‘T’ai Shen’ in the traditional Taiwan. Taiwan Historical Research 3, 143–193.


