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CLINICAL PAPER

Effects of water- and land-based exercise programmes on women experiencing pregnancy-related pelvic girdle pain: a randomized controlled feasibility study

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Abstract

The aims of this study were to address: whether a water-based exercise programme decreased pain in pregnant patients with pelvic girdle pain (PGP), and improved their quality of life, in comparison to a land-based exercise programme; and the feasibility of undertaking a large-scale research project. Twenty-three participants with a diagnosis of PGP were recruited at St George's Hospital, London, UK, and randomized into two groups, and prescribed either water- or land-based exercise. Each group received four, weekly exercise sessions on land or in water. The effects of the exercise on PGP were measured using the Pelvic Girdle Pain Questionnaire (PGPQ; the primary outcome), a visual analogue scale, the Patient-Specific Functional Scale (PSFS) and the active straight-leg raise (ASLR) test. Quality of life was measured using the Subjective Exercise Experience Scale (SEES). Outcomes were assessed at baseline and after 4 weeks of exercise. The results showed that there was a clinically significant improvement in all outcome measures in the water-based exercise group in comparison to the land-based one. A statistically significant difference between groups was shown for the ASLR ($P = 0.036$), and the Positive Well-Being ($P = 0.000$) and Fatigue subscales of the SEES ($P = 0.011$). No statistical differences were found between the scores for the PGPQ ($P = 0.056$), PSFS ($P = 0.530$) and Psychological Distress subscale of the SEES ($P = 0.712$). Exercise in water appears to offer greater clinical benefits to patients who are experiencing PGP in comparison to land-based exercise, particularly with regard to the SEES Fatigue and Positive Well-Being subscales, and ASLR scores. The statistical significance of the differences between the two groups was limited by the small sample size, and because no power calculation was used. Nevertheless, the methodology and results suggest that a larger study of this kind could provide more-definitive conclusions to support the use of water-based exercise therapy for PGP.

Keywords: hydrotherapy, pelvic girdle pain, physical therapy, pregnancy, quality of life.

Introduction

Pelvic girdle pain (PGP) is a musculoskeletal condition that is localized in the anterior or posterior aspect of the pelvic ring, and affects approximately 20% of pregnant women (Wu *et al.* 2004; Skaggs *et al.* 2007). Studies have shown that PGP reduces endurance for weight-bearing activities, and has an impact on functional activities such as turning in bed, standing on one leg and riding in a car (Huijbregts 2004; Nightingale 2013). The condition has been linked with longer periods of sick leave, feelings of psychological distress and reduced health-related quality of life (QoL) (Olsson & Nilsson-Wikmar 2004; Valim *et al.* 2011). There

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is no consensus in the current research about the aetiology of PGP, but the most widely accepted biomechanical model is multifactorial. It has been suggested that hormonal changes, altered biomechanical and neuromuscular control around the pelvis, and increased weight gain as a result of pregnancy all contribute to its onset (Albert *et al.* 2006; Beales *et al.* 2009).

Exercise guidelines recommend treatments for PGP that aim to improve pelvic neuromuscular control, stability and mobility (Vleeming *et al.* 2008). Although the best management approaches for this condition are still being debated (e.g. the optimal treatment frequency), group exercise on land targeted at strengthening the stabilizing pelvic muscles and increasing lumbar spine stiffness has been shown to reduce PGP and improve QoL (Richardson *et al.* 2002; Mørkved *et al.* 2007; Pennick & Liddle 2013).

Exercising in water has been advocated as an alternative when a land-based routine becomes more challenging, and this has also been linked with increased maternal satisfaction (Katz 2003; Cluett & Burns 2009). Hydrotherapy has been endorsed in order to encourage regular exercise during pregnancy and increase attendance at exercise classes, which offers a possible economic benefit to women's health departments (Epps *et al.* 2005; Cavalcante *et al.* 2009). The benefits of hydrotherapy are that normal movement patterns can be optimized by reducing weight-bearing on the affected joints, and the thermodynamic properties of water have been shown to reduce pain during pregnancy (Kramer & McDonald 2006; Smith & Michel 2006; Gayiti *et al.* 2015).

Two studies have shown that aerobic water-based exercise and "gymnastics" reduce pain and periods of sick leave in pregnant patients (Kihlstrand *et al.* 1999; Granath *et al.* 2006), but neither assessed the impact of stability exercise on PGP. Both of these studies employed relaxation as part of the exercise programmes, which has been shown to improve post-pregnancy outcomes (Chuang *et al.* 2012). There is disagreement regarding the optimal methods to accurately diagnose PGP, but it has been recommended that objective testing is undertaken to assess mechanical dysfunction around the pelvis, although no previous studies of water-based exercise have done this, limiting the conclusions that can be drawn about the specific impact of hydrotherapy on PGP (Vleeming *et al.* 2008; Kibsgård *et al.* 2012). No studies have assessed the effects of physiotherapy-led water exercise programmes in pregnancy, where it has been argued that a specialist therapist might be better equipped to address movement control problems, in comparison to general exercise classes (Bø & Haakstad 2011; ACPWH 2013).

Because of discrepancies in methodologies, the results of studies of the effects of exercise in water on QoL are currently inconclusive, but the evidence indicates that water-based exercise is the treatment of choice for many patients (Lox & Treasure 2000; Valim *et al.* 2011). An inability to select an intervention group has been cited as a reason for the high drop-out rates reported in previous research on water-based exercise in which patient choice is advocated for exercise during pregnancy (Artal & O'Toole 2003). Despite the possible benefits of exercise in water in comparison to land-based programmes, the guidelines do not recommend one treatment over the other and no studies have assessed the impact on PGP of exercising stabilizing muscles in water, so further research is of value to improve patients' clinical outcomes (Vleeming *et al.* 2008). The aims of the present study were to compare the effects of water- and land-based exercise on PGP and QoL, and assess the feasibility of future larger-scale research that may support clinical recommendations, justify class set-up and treatment frequency, and modify study methodology.

Participants and methods

A purposive sample of 23 participants was recruited over 4 months at the Women's and Men's Health Physiotherapy Department, St George's Hospital, London, UK. The study was given ethical approval by the University of Bradford, Bradford, UK, and the London – City and East Research Ethics Committee and the local research authority. All the practitioners who took part in the research received training from the lead researcher (K.L.S.). The participants were over 18 years old, more than 12 weeks pregnant and able to speak English. Women were excluded from the present study if they had uncontrolled blood pressure, placenta praevia, pre-eclampsia, obstetric cholestasis, uncontrolled asthma, unstable respiratory or cardiac conditions, open skin wounds, or methicillin-resistant *Staphylococcus aureus* (Weiss Kelly *et al.* 2005; Stowers & Babb 2006). To allow for safe hoist evacuation from a pool, the participants weighed less than approximately 100 kg, and women were excluded if they were taking part in other trials of exercise in pregnancy (Curtis & Drennan 2013).

A treating specialist physiotherapist recruited participants during their first, 45-min assessment. This appointment included subjective and objective assessments, and standardized advice on posture, activity modification, PGP education and basic management strategies was provided (Vleeming *et al.* 2008). A diagnosis of PGP was given if subjective reporting suggested that a participant's PGP was caused by a minimum of two daily activities, and she had three positive pain-provocation tests (Laslet *et al.* 2005) and a positive active straight-leg raise (ASLR) test (Mens *et al.* 2001; Huijbregts 2004; O'Sullivan & Beales 2007; Vleeming *et al.* 2008). All participants were provided with standardized written information (i.e. a participant information sheet), their telephone numbers were taken, and permission was sought to contact them in order to proceed with the trial. They were given 7 days to accept. Inclusion in the study was confirmed by telephone by the lead researcher (K.L.S.), and all participants attended the Women's and Men's Health Physiotherapy Department prior to commencing treatment so that they could sign the consent forms. Individuals could withdraw from the study at any stage. In the absence of previous research on the present subject, a power analysis calculation was not undertaken, and the sample size was based on current referral numbers for patients with PGP at the hospital (Curtis & Drennan 2013).

Interventions

The participants were randomly allocated into water- or land-based exercise groups by computerized randomization. The two groups were pre-stratified into blocks for gestation and parity, and were randomized from this, which meant that variables known to influence the severity of PGP were balanced between them at baseline (Skaggs *et al.* 2007; Kovacs *et al.* 2012; George *et al.* 2013; Mahishale & Borker 2015). Participants who wished to choose their intervention were permitted to take part in order to prevent drop-outs, and also fulfil the ethical requirements set by London – City and East Research Ethics Committee, i.e. to allow patient intervention choice to play a part in this pilot study, in the absence of previous research on this topic. However, there was no statistical analysis of these results in order to prevent the introduction of bias from perceived treatment effects. The recruitment process is summarized in Figure 1.

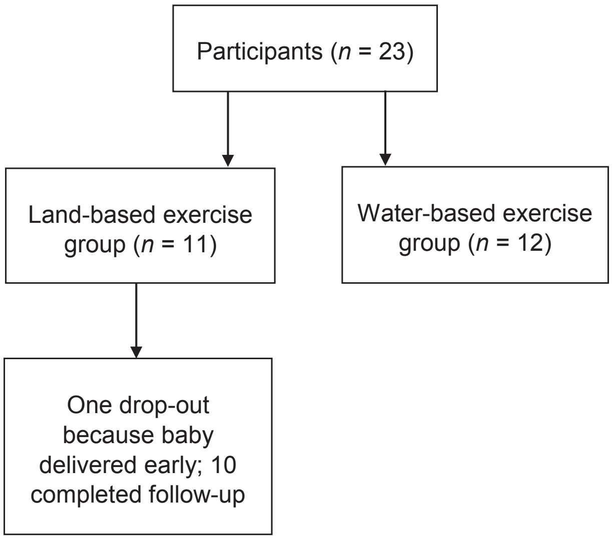

Figure 1. Flow diagram showing the recruitment of participants for the study, and the number of drop-outs.

One participant was lost to follow-up because her baby was delivered early and she could not be contacted. Therefore, the data were not assessed with an intention-to-treat analysis. All the participants were offered further follow-up following the completion of the study. Each group undertook four, weekly exercise sessions that included warm-up, cool-down, relaxation, pelvic control and stability exercises. Both programmes focused on similar exercise and muscle groups, but because one took place in an aquatic medium, these could not be exactly matched. Participants in both groups were shown exercise progressions depending on their ability and level of improvement (Elden *et al.* 2005). The hydrotherapy pool did not exceed a temperature of 36 °C so as to prevent any harm coming to the foetus (Cluett & Burns 2009).

Outcome measures

The outcome measures were collected at baseline and after 4 weeks of exercise. The primary outcome measure was the Pelvic Girdle Pain Questionnaire (PGPQ). A score change of 7 was set as a clinically significant difference (Stuge *et al.* 2011). The secondary outcome measures assessing pain and function were a visual analogue scale (VAS) (a score change of 1.5 was set as clinically significant), the Patient-Specific Functional Scale (PSFS) (a score change of 1 was set as clinically significant) and the ALSR test (a score change of 1 was set as clinically significant) (Mens *et al.* 2001; Lukacz *et al.* 2004; Pengel *et al.* 2004). Quality of life was assessed using the Subjective Exercise Experience Scale (SEES), which analyses feeling states

Table 1. Demographic characteristics of the study participants (total $n = 23$)

Exercise group	Total (*n*)	Age range (years)	Trimester (*n*)		Parity (*n*)		Previous history of low back pain/pelvic girdle pain (*n*)	
			Second	Third	Multiparous	Nulliparous	Twin pregnancy	History of chronic hip pain
Water-based	12*	26–35	6	6	6	6	1	0
Land-based	11	22–37	5	6	5	6	0	1

*One participant chose to be included in this group.

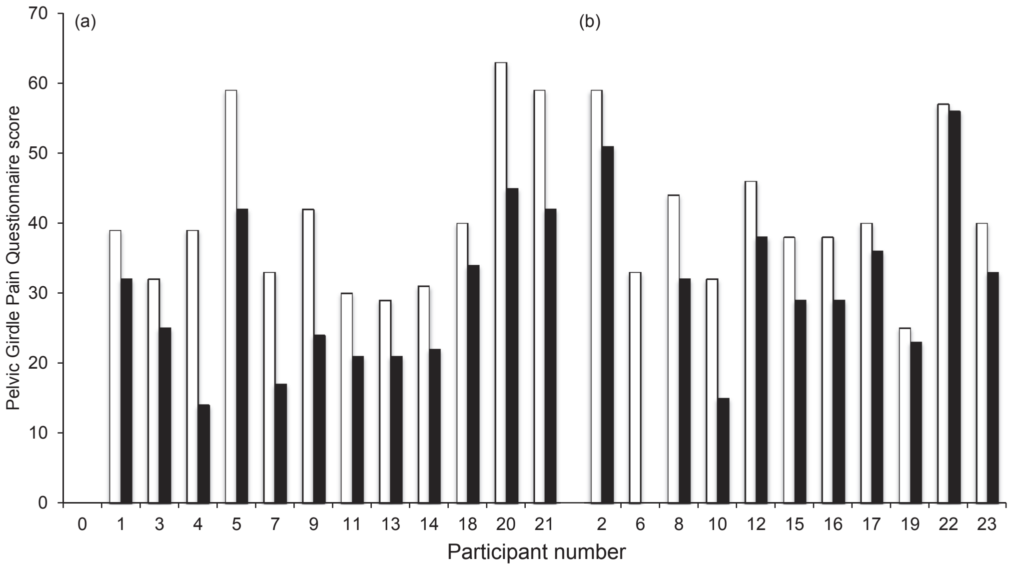

Figure 2. Pelvic Girdle Pain Questionnaire scores for each participant in the (a) water- and (b) land-based exercise groups before (□) and after (■) the intervention.

using Fatigue, Psychological Distress and Positive Well-Being subscales. A score change of 1.5 was considered clinically significant for each element (Lox & Treasure 2000). The data were analysed by the lead researcher (K.L.S.).

Results

The demographic characteristics of the 23 participants ($n = 23$) are summarized in Table 1.

The age range of the sample was 22–37 years [mean = 31.9 years, standard deviation (SD) = 3.95]. Twelve and 11 participants undertook the water- and land-based exercise regimes, respectively. One subject (participant 20) chose the water-based treatment group because this was her preferred exercise medium, and therefore, her results are discussed but excluded from further analysis. Both groups were balanced and had comparable outcome measure scores at baseline, and all the participants completed all four exercise sessions.

Pelvic Girdle Pain Questionnaire

The average mean difference in PGPQ scores before and after land-based exercise was 7.7 [SD = 4.71, standard error (SE) = 0.687]. There was a larger average mean difference in the PGPQ scores before and after water-based exercise of 12.64 (SD = 6.21, SE = 0.661). Figure 2 shows that all the participants' PGPQ scores improved before and after the interventions, regardless of which treatment was provided. The data for participant 20, who chose her treatment allocation, were in keeping with the rest of the results from those in the water-based exercise group.

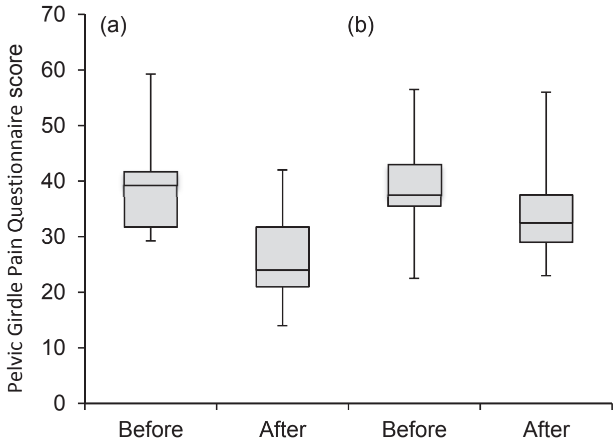

Figure 3. Box-and-whisker plots showing Pelvic Girdle Pain Questionnaire score medians, quartiles and ranges of data for the (a) water- and (b) land-based exercise groups before and after the intervention.

A box-and-whisker plot (Fig. 3) shows that results improved in the water-based exercise group, but were similar before and after the intervention for the participants performing land-based exercises. Since the clinically significant score change was set as a difference of 7, both groups demonstrated clinically significant differences after the intervention, but the water-based exercise group showed a greater change.

The PGPQ data were analysed for normal distribution using the Shapiro–Wilk test, and an independent Student's *t*-test using SPSS Statistics, Version 24 (IBM Corporation, Armonk, NY, USA) was undertaken to compare the mean results for both groups before and after the intervention. These results were not shown to be statistically significant ($P = 0.056$). Ninety-five per cent confidence intervals (CIs) lie within $0.178 < u < 9.965$, where u is the population studied. The Cohen's d effect size was 0.895, showing that there is a large effect size and a consistent difference between the groups assessed.

Visual analogue scale

In the land-based exercise group, the mean difference before and after the intervention was 2.5 (SD = 2.68, SE = 0.687). The average mean difference after the intervention was larger in the water-based exercise group: 4.05 (SD = 1.59, SE = 0.661). A clinically significant change was set as a score difference of 1.5, and therefore, both groups demonstrated a clinically significant improvement in VAS scores, but the difference in the water-based exercise group was greater. There was no statistical difference in VAS scores before and after the intervention for the water- and land-based exercise groups ($P = 0.120$, 95% CI = $-0.316 < u < 3.407$). The Cohen's d effect size was 0.165, showing no consistent difference between the groups.

Active straight-leg raise test

The mean ALSR test score difference before and after land-based exercise was 0.9 (SD = 1.2, SE = 0.667), as compared to a larger mean difference in the water-based exercise group of 1.82 (SD = 0.663, SE = 0.661). Clinical significance was set as 1, and therefore, those performing land-based exercise did not demonstrate a clinically valuable change, whereas those performing water-based exercise did.

A statistically significant difference was found between the groups in terms of the ALSR test scores ($P = 0.036$, 95% CI = $1.518 < u < 8.5000$). The Cohen's d effect size showed a consistent difference between the groups (0.969).

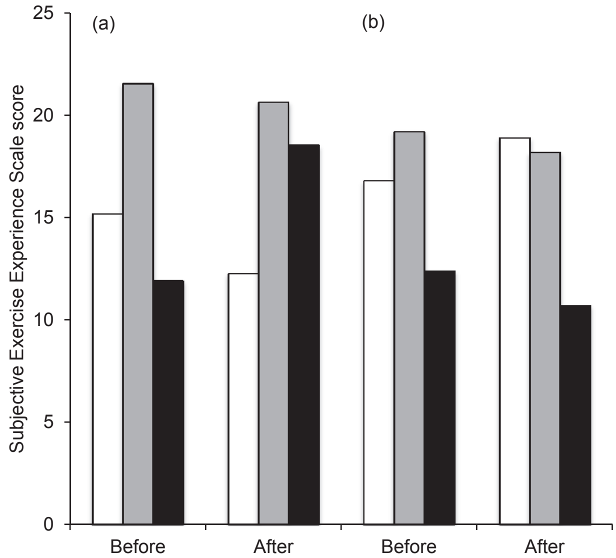

Figure 4. Mean differences in the Fatigue (□), Psychological Distress (▩) and Positive Well-Being (■) subscale scores on the Subjective Exercise Experience Scale for the (a) water- and (b) land-based exercise groups before and after the intervention.

Patient-Specific Functional Scale

The mean PSFS difference before and after the intervention in the land-based exercise group was 0.9 (SD = 2.13, SE = 1.687), as compared to the water-based exercise group, who demonstrated a larger mean difference of 1.7 (SD = 2.02, SE = 0.661). Clinical significance was set as a difference of 1, and therefore, those performing land-based exercise did not demonstrate a clinically significant change, whereas those performing water-based exercise did. No statistical difference was found between the groups ($P = 0.530$, 95% CI = $-2.351 < u < 1.194$). The Cohen's d effect size was 0.279.

Subjective Exercise Experience Scale

The mean differences in SEES scores before and after the intervention are shown in Fig. 4.

In the land-based exercise group, feelings of fatigue increased by an average of 2.1 (SD = 1.60, SE = 0.687), as compared to a clinically significant (difference > 1) average reduction in the Fatigue subscale score in the water-based exercise group of 2.9 (SD = 5.41, SE = 0.661). A statistically significant difference was found between the groups ($P = 0.011$, 95% CI = $1.518 < u < 8.5000$).

In the land-based exercise group, Positive Well-Being subscale scores reduced by an average of 1.7 (SD = 3.91, SE = 0.687), as compared to the water-based exercise group, who showed an average increase in this score after exercise of 6.64, which is considered clinically significant (SD = 2.80, SE = 0.661). The differences between the groups were statistically significant ($P = 0.000$, 95% CI = $-11.228 < u < -5.445$).

The mean score for the Psychological Distress subscale reduced by 1.0 in the land-based exercise group (SD = 3.60, SE = 0.687), which was not considered to be clinically significant, as compared to the water-based exercise group, who showed an average reduction of 1.64, which was considered to be clinically significant (SD = 4.43, SE = 0.661). The differences in the scores were not statistically significant ($P = 0.712$, 95% CI = $-2.689 < u < 3.962$).

Discussion

The present study demonstrates that there was a clinically significant difference between land- and water-based exercise in terms of improving PGP and QoL in pregnant patients, an acknowledged lack of power resulting from the small number of participants recruited notwithstanding. Although the statistical differences for the PGPQ, VAS and PSFS scores are not shown, these were demonstrated for scores on the ASLR test, and the SEES Positive Well-Being and Fatigue subscales. The sample effect sizes were large, showing a consistent difference between groups. Therefore, any conclusions must be tentative at this stage. The results of the present research support the conclusions of Kihlstrand *et al.* (1999), Lox & Treasure (2000) and Granath *et al.* (2006), who all showed that water-based exercise improves pain and QoL in pregnant patients.

The clinical differences in the PGPQ scores are supported by the theory that pelvic stability exercise optimizes neuromuscular control and lumbar spine stiffness, which are both known to influence PGP (Vleeming 1990; Snijders *et al.* 1993a, b). A lack of sufficient power in the present study limits the application of these results to the general population, and explains why the PGPQ scores were not statistically significant, but the possible clinical value of using hydrotherapy should not be overlooked (Bowling 2014).

The improvements in the PGPQ, ASLR test and PSFS scores were probably the result of water buoyancy, which reduces stress on affected joints and ameliorates weight transference caused by the baby bump, optimizing pelvic stability and improving function (Kanakaris *et al.* 2011). The thermodynamic properties of exercise in water are linked with a reduction in pain during pregnancy that reduces muscular tension around the pelvis, which may explain the improvement in VAS scores in the water-based exercise group (Gayiti *et al.* 2015). The persistent fatigue and pain exhibited by the land-based exercise group may have had an impact on proprioception around the pelvis, reducing muscle function, limiting response to exercise, and therefore, preventing a significant improvement in the ASLR test and PSFS scores in these participants. The improvements in the ASLR test scores of the water-based exercise group support the use of a specialized physiotherapy-led programme.

There is a lack of specific clinical outcome measures to assess PGP, although measures such as the PSFS are validated for use with lower back pain. It is possible that this measure was not as sensitive to detecting changes in PGP, which may explain the failure to show any statistical significance (Beaton 2000).

The improvements in SEES Psychological Distress subscale scores in both groups may be a result of health education and reassurance reducing stress in patients who were experiencing pain, rather than the exercise intervention itself (Wong *et al.* 2011). The improvements in the SEES Fatigue subscale scores in the water-based exercise group may be a result of relaxation in water increasing feelings of maternal satisfaction (Fink *et al.* 2012; Gayiti *et al.* 2015). The changes in the Positive Well-Being subscale scores are somewhat surprising, and it is proposed that the reasons for this are environmental. The water-based exercise class was undertaken a quiet hydrotherapy pool, where music is played to promote relaxation, but the land-based exercise session took place in a busy hospital gymnasium, which was not as relaxing an environment, which perhaps may have had an impact on the negative outcomes (Cepeda *et al.* 2006).

Study limitations and recommendations

The results of the present study support the exercise class approach to treatment, and suggest that larger-scale research will be feasible. Since this research was conducted as part of a Master's degree, it was not possible to blind the lead researcher (K.L.S.) to participant group allocation. Where the class environment has been cited as a possible reason for differences in group outcomes, it is recommended that land-based exercise classes are run at times when the gymnasium is not being used by other patients, an approach that promotes relaxation in a larger study. The methodology of the present trial did not control for the influence of co-interventions that could influence PGP. In a larger trial, home exercise regimes should be recorded in order to analyse the effects of any co-intervention, and ensure that changes in outcome measures are only the result of the primary intervention (Campbell-Yeo *et al.* 2009). Future research should use a power calculation to avoid the introduction of a type II sampling error, and allow for an adequate sample size in order to detect statistical differences in outcomes and provide definitive conclusions that can inform clinical decision-making on PGP management (Bowling 2014).

Conclusions

The present research shows that exercising in water and on land improves the clinical outcomes of women with PGP, supporting the recommendation that it should be considered as a treatment option. Exercising in water may be more beneficial in improving pain, function and positive well-being compared to a land-based regime, and consideration of its use is of value when patients struggle to exercise in the latter stages of pregnancy. A larger research study to assess the statistical differences between these groups is both feasible and recommended, and would allow the results to be applied to the general population of women with PGP.

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