Etiology of Lumbar Pain in Pregnancy

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Abstract

The complaint of lower back pain (LBP) is not uncommon amid pregnant women, an average of 62.5 % experience LBP during pregnancy [6, 7, 13, 16, 32]. Regardless of its prevalence the etiology of back pain, lumbar pain in particular has not yet been proven; postural and endocrine changes however, have been implicated as a possible cause of back pain in pregnancy.

Using the electronic journals and database from Victoria University, a total of 71 articles were identified and the 33 that contained original data about back pain, especially lumbar pain in pregnancy were reviewed.

The literature reviewed emphasized two causes of back pain in pregnancy, that being postural and endocrine changes. The evidence supporting either cause of lumbar pain in pregnancy remains inconclusive. The majority of the studies reviewed failed to provide adequate methodology and specificity. Among the possible causes of lumbar pain, predisposing factors such as age, history of back pain and type of work are thought to play a role in the etiology of lumbar pain in pregnancy. To this day, research in this area has been negligible [3] and further research is essential in order to specifically identify the cause of lumbar pain in pregnancy.

Key words: lumbar back pain, pregnancy, etiology.

Introduction

Pregnancy is the period of gestation that involves profound physiological changes which together with the physical adjustments brought about by the pregnancy itself, can have considerable implications for the comfort of the woman during pregnancy [7].

"Back pain" has been reported in 50-75% [6, 7, 13, 16, 32] of women during pregnancy and despite this relatively high incidence, research carried out in an attempt to identify the specific cause of this type of back pain has been limited. So far the term "back pain" has not been clearly defined and can encompass different groups of pain. Recently however, these subgroups are being individually defined and classified; these will be discussed in further detail in the sections below.

The aim of this literature review is to critically evaluate the research that has been carried out with reference to back pain, lumbar pain in particular and so provide a better understanding and a possible explanation behind the etiology of lumbar pain during pregnancy.

Definition of lumbar pain

Lumbar pain is very commonly covered under the general concept of "back pain". More recently however, a greater attempt has been made throughout the literature to define and classify different subgroups within the back pain population during pregnancy (refer to appendix (i)). It is important to therefore define and distinguish between lumbar pain and other types of complaints especially, that of posterior pelvic pain. The clinical characteristics between lumbar and posterior pelvic pain although different, sometimes tend to overlap and in some cases present simultaneously in clinical practice. A reference on this matter was made by Ostgaard et al [26]. This study depicted the importance of differentiating and correctly defining lumbar pain from posterior pelvic pain. The authors acknowledged the need for this differentiation as it allowed for an individualized, more efficient treatment approach. In this particular study, sick leave was significantly reduced ($P<0.01$) among women in the lumbar pain group.

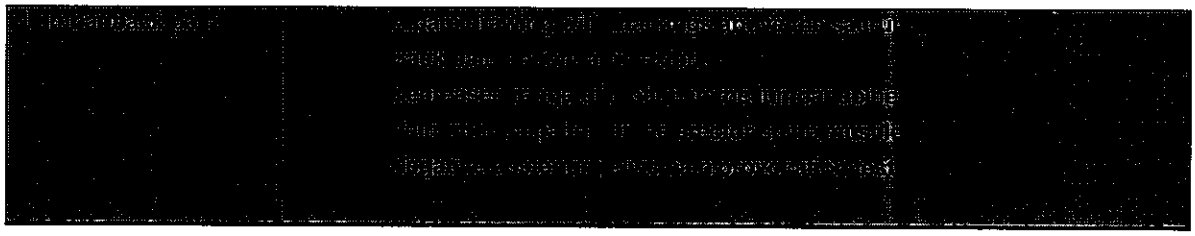
Classification of lumbar pain in pregnancy

Back pain is very common during the course of pregnancy, so common that it is often regarded as a normal part of pregnancy [20]. Different classification criteria have been used in some studies to separate lumbar pain from posterior pelvic pain; a combination of a simple questionnaire, pain drawing and pelvic pain provocation tests have been used to identify between the two. A larger proportion of studies investigating back pain in pregnancy fail to exclusively distinguish however, between lumbar pain and posterior pelvic pain [3, 6, 7, 9, 21, 22, 23, 25, 29, 31, 32, 33]. Those studies that have clearly classified lumbar pain will be discussed in further detail below.

Ostgaard et al [26] used a questionnaire to specify the patient's pain, including a pain drawing, a visual-analog scale (VAS) to estimate the patient's pain intensity and the posterior pelvic pain provocation test. The posterior pelvic test required the patient to lie supine. One leg is flexed 90^0 at the hip and knee joint, pressure is exerted down the femur into the pelvis [1]. No statistically significant differences in incidence or pain intensity between women with back pain and posterior pelvic pain were found. Back school education and training program was found to reduce lower back pain ($P<0.05$). This combination which included simple anatomy, posture physiology, lifting and working technique, muscle training and relaxation training provided significant results. Sick leave in the group that received individualized back school education and training program according to the woman's specific type of problem was reported significantly less compared to the other groups.

The study by Noren et al [20] followed similar classification method as Ostgaard et al [26] previously mentioned, with the variant that in this present study two additional pain groups were considered (refer to table 1) in the classification criteria. Noren et al [20] defined five different pain groups which were used as criteria to classify the type of pain. These are shown on the Table 1.

Table 1 Pain groups defined by Noren et al [20].



Posterior Pelvic Pain	A pain drawing with markings distal and lateral to L5. A history of time and weight-bearing-related pain in the posterior pelvis deep in the gluteal area. Pain free intervals. Free range of motion in the spine and hips and no nerve root syndrome. Positive posterior pelvic pain provocation test.
Nerve root syndrome	Pain in the back with anatomically correct radiation into the leg and foot. Positive straight leg raising test. Reduced muscle strength and numbness. Negative posterior pelvic pain provocation test.

Unfortunately this study does not comment on the possible difference in time of onset between lumbar and posterior pelvic pain which could have been of use in trying to identify distinct characteristics between the two types of pain. Berg et al [3] suggested that in women with specific "SIJ dysfunction", low back pain began in the second trimester. The study however, failed to classify or define lower back pain. The authors' low back pain population was in fact, determined by pain provocation tests at the sacroiliac joint (SIJ). This would tend to suggest that these results are indicative for pelvic pain rather than of lumbar origin. In another study by Wedenberg et al [33] (n = 60), the authors concluded that acupuncture relieved pain and diminished disability in low back pain during pregnancy better than physiotherapy. Although the study diagnosed each participant with a particular type of pain (pelvic, low back or both), the study failed to refer to this classification further on in the study. Thus the results obtained were unclear.

Finally to demonstrate the diversity of classifications criteria used in the literature, Requejo et al[29] proposed a modified approach where instead of trying to differentiate lumbar from posterior pelvic pain, the cause of lower back pain was determined through a comprehensive history and a diagnostic elimination process. This modified classification system is certainly not a new concept; instead it is a review of assessment procedures already proposed in clinical practice [2, 18]. Although the author purports this approach would provide a safe ethical classification, it is based on a single case study and therefore has no external validity within a larger population.

A prospective, randomized control study with a higher statistical power is necessary to establish the efficiency of the proposed approach of classification and treatment outlined in this case report.

Overall, in accordance to the literature reviewed, a definition of lumbar pain which can safely be used to describe pain from lumbar origin is the following:

Lumbar pain: pain arising from the lumbar area only, often present earlier in life. The pain is provoked in the lumbar spine by lateral side bending, extension (Quadrant test) and palpation of the paravertebral muscles. Motion of the lumbar spine is reduced, however pain on walking, climbing up stairs or other weight bearing activities is usually spared.

Classification: lumbar pain can be distinguished from posterior pelvic pain through a combination of test; medical history and clinical examination, these are described below.

- Medical history: to identify risk factors, e.g. previous lumbar pain, previous trauma, personal habits, works requirements etc. Pain causing activities, for example, walking would indicate pelvic rather than lumbar involvement. Location of pain and pain modality is identified through a pain diagram and intensity of the pain is measured by visual analog scales.

- Clinical examination of the lumbar spine and pelvis: to identify motion restriction of the lumbar spine as well as pain provocation tests which are more specific to a segmental level. Pelvic screen would include pain provocation tests.

A lot of current research regarding back pain in pregnancy has been on the pelvis. In addition to postural changes, the pelvis is also influenced by hormonal changes such as the secretion of relaxin (which prepares the pelvis for parturition), making the pelvis a likely pain producing structure. Notwithstanding, the aim of this review is to analyze the lumbar region as a possible cause of back pain in pregnancy and provide an improved understanding of this concept for further research.

Etiology

LBP has been attributed to increased biomechanical strain or an altered hormonal influence during pregnancy. Any one of these factors or a combination may be involved in the pathophysiology [12]. The following sections will examine postural as well as endocrine changes during pregnancy in an attempt to evaluate whether these changes are responsible for lumbar pain in pregnancy. In addition, it is acknowledged that although lumbar disc herniation has the potential to cause lumbar pain during pregnancy, the incidence is extremely low. In a prospective study LaBan et al [14] reported the incidence of disc herniation in a very strong sample size (n = 48, 760) of pregnant women to be negligible (5 cases reported or 1:10, 000). With such low clinical incidence, further discussion of disc herniation as a possible etiology of low back pain in pregnancy will not be followed.

Postural Changes during Pregnancy

Studies that have assessed postural changes during pregnancy are few [7, 9, and 25] and although never substantiated, postural changes have often been implicated as a major cause of back pain in pregnant women [3, 9]. Bullock et al [7], Frankling et al [9] and Ostgaard et al [25] are prospective studies that have used validated methodology to investigate specifically the influence of postural changes on back pain during pregnancy. A common limitation however, to these studies has been the failure to distinguish between lumbar pain and posterior pelvic pain.

In the study by Bullock et at [7] (N=34), the progressive changes in degrees of thoracic kyphosis, lumbar lordosis and pelvic tilt in the saggital plane were measured and statistically analyzed using a three one-way analysis of variance (ANOVA). Although the findings revealed significant change in the lumbar lordosis and thoracic kyphosis ($P<0.05$) especially during the period between the 4th and the 9th month of pregnancy, the only significant difference between those with and without pain occurred for kyphosis in the second trimester. Those people with pain had a higher mean thoracic kyphosis than those without ($P=0.045$).

Franklin et al [9] set out to investigate postural changes that occur between the first and third trimesters of pregnancy and determine how these changes were related to back pain. Completed more than 10 years after Bullock[7] study, Franklin et al [9] had access to more advanced instruments for the methodology employed in the study yet the results obtained confirmed what had been previously published by Bullock[7]. That is, there is no doubt that significant postural changes do take place during the course of pregnancy however these changes do not appear to correlate to back pain. A Metrecom Skeletal Analysis System was used to assess postural alignment in Franklin et al [9] study. The study found significant differences ($P<0.01$) between the first and third trimester posture for lumbar angle, head position and pelvic tilt. These results suggested that in the standing position the lumbar lordosis and saggital anterior pelvic tilt increased. Aside from these findings no significant relationship was found between magnitude of or change in posture and back pain scores.

Another prospective study that investigated the postural changes in pregnancy was Ostgaard et al [25]. The study found that complaints of back pain correlated significantly with large saggital ($P<0.01$) and large transverse abdominal diameter ($P<0.01$). An interesting finding was also reported concerning lumbar lordosis; in that back pain was statistically correlated to a large initial lumbar lordosis ($P<0.01$). Throughout the course of pregnancy, lumbar lordosis was expected to increase during the enlargement of the abdomen but this however, failed to occur. This study suggests that an initially large lumbar lordosis was a risk factor for back pain in pregnancy.

In light of these studies it is reliable to conclude that in pregnancy postural changes do definitely occur. The effect that these changes have on back pain, in particular lumbar pain remains inconclusive except for the statistically significant findings that thoracic kyphosis and large saggital and transverse abdominal diameter correlate to back pain in pregnancy. Franklin et al [9] hypothesized that significant skeletal alignment changes that are related to back pain could be occurring but may not be directly measured by postural assessments suggesting that more research in this field is required. Other studies that partly looked at the effect of postural changes on back pain in pregnancy are Bjorklund et al [4] and Kristiansson et al [12] where symphyseal distention and the distribution of pain were investigated respectively.

In a recent study by Bjorklund et al [4] a statistically significant increase in symphyseal width between 12 and 35 weeks of pregnancy was found in pregnant women suffering from mild and disabling pelvic pain ($p<0.001$) ($p=0.008$) respectively . The severity of the pain was not found to be a predictor of the degree of symphyseal distention in the individual case.

In a longitudinal, prospective observational study by Kristiansson et al [12] it was found that the distribution of back pain differed depending on when the pain actually started, that is, whether the onset of the pain was before or during pregnancy. If the pain started during the pregnancy, sacral pain was the most common, followed by lumbosacral pain, lumbar, thoracic and cervical pain. If the pain started before pregnancy it was found that lumbar and thoracic were most common during first trimester, in the third trimester the pattern was similar to those who had their pain onset during pregnancy. The study also reported that back pain started early in pregnancy and the incidence leveled off during the twenty-fourth week of gestation.

Finally, an important aspect of postural change worth mentioning is the possible relationship between weight gain and back pain in pregnancy. Fast et al [8], Kristiansson et al [12] and Ostgaard et al [24] looked at this weight gain variable and did not find a correlation. These studies concluded that while mechanical factors may contribute to the development of pain, these findings cannot be explained by just biomechanical overloading. Fast et al [8] also did not find the pain distribution to follow the distribution of weight gain in pregnancy. It was further stated that if the relationship between weight gain and back pain were a direct one, the number of patients complaining of back pain would be expected to increase as the pregnancy progressed.

Endocrine Changes

Most of the literature concerning the endocrine changes endured by women in particular the effect of serum relaxin on back pain in pregnancy, has mainly concentrated on pelvic pain and the pelvic girdle. It is easy to see how this is the case, as mentioned in the introduction the pelvis is greatly affected by hormonal changes which prepare it for parturition. As a result of this, it has been the pelvis rather than the lower back which has been most widely studied. However, this information will still be reviewed but it will then be related back into the context of the lumbar back and the possible role of endocrine changes in the etiology of lumbar pain.

Relaxin is a polypeptide hormone that regulates collagen and softens the ligaments of the pelvis, preparing the pelvis for parturition. The role of serum relaxin and the possible influence of the combined oral contraceptive (COC) on back pain during pregnancy will be reviewed in the following paragraphs. Serum relaxin levels peak in week 10-14 in normal singleton pregnancy; during week 14-22 relaxin concentration appears to decrease gradually and the concentration remains almost constant from the 24th week of pregnancy [13, 27].

MacLennan et al [16, 17] has carried out various studies in an attempt to understand the role of relaxin in relation to human reproduction and ligamentous changes in pregnancy. Two of these studies which looked at serum relaxin and pelvic pain, although they had slightly different methodology obtained a similar conclusion [16, 17]. They both identified and postulated two main concepts; firstly, that the highest relaxin levels during pregnancy were found in patients who were most incapacitated clinically. The study used these results to propose an association between high serum relaxin levels and pelvic pain and joint laxity during pregnancy. Secondly the susceptibility to circulating or local concentrations of relaxin may vary between patients. This explained why patients in the control, who had moderately high relaxin levels did not have any symptoms[17]. Overall the study suggests that patients who are more receptive to relaxin are more prone to pelvic joint relaxation. In support of this study Kristiansson et al [13] also found an association between relaxin level and pain in the pelvic area but no relationship was seen with pain intensity or degree of disability. These results support the theory that relaxin is involved in the generation of pelvic pain in pregnant women in some way.

More recent studies by Bojrklund [4], Hansen [10] and Petersen [28] were unable to confirm the findings made by MacLennan [16, 17] and Kristiansson [13]. These studies criticized the findings made by MacLennan on the grounds that porcine relaxin was used to measure the relaxin concentration in the sample of pregnant women. Porcine and human relaxin has been known to differ in 50% of the amino acid sequency [28]. This marked species specificity of relaxin was held responsible for the conflicting results found between MacLennan[16, 17] and the other studies [4, 10, 28]. Furthermore, the study by Bojrklund et al [4] concluded that serum relaxin levels were not associated with the degree of symphyseal distention nor with pelvic pain in pregnancy.

Other endocrine changes experienced during pregnancy or that influenced pregnancy in any way were encountered in this review. Reference is made to menstrual pain and the use of COC, and these are discussed below.

A number of studies have investigated the effect of COC on the menstrual cycle and on relaxin. In non pregnant women, a study by Wreje et al [34] demonstrated that the serum relaxin levels tend to vary throughout the menstrual cycle. Women with posterior pelvic pain had detectable relaxin values significantly more often ($p<0.001$) than the group of healthy women. During the use of COC the serum relaxin levels were quantified contrary to that expected if relaxin secretion were dependent on ovulation; mean values were found to be higher than during the normal menstrual cycle. This study suggested the existence of sources for relaxin production other than the corpus luteum in the non-pregnant women. This reinforces the idea that relaxin levels can have an effect on back pain in general.

The study by Bjoklund et al [5] on the use of COC found no association between the duration of COC use and back and pelvic pain during pregnancy. The study (N=161) was of prospective design and a questionnaire was used to obtain the data. This present study also concluded than non users or short term users of COC had an increased risk of persistent back or pelvic pain after delivery compared to long term users.

Finally other studies that have partly looked at endocrine changes and their effect on back pain in pregnancy are Berg et al [3] and Ostgaard et al [25]. These studies found no correlation between back pain and the use of COC.

The role of relaxin is still being studied; relaxin is not specific to pregnancy but is also present in healthy non pregnant women. Relaxin is thought to relax connective tissue by decreasing its intrinsic strength, allowing it to expand and lose its rigidity [17]. It has been believed for many years that serum relaxin is what causes excessive laxity that result in instability of the pelvic joints during pregnancy. This explains why relaxin can cause instability in the pelvic joints but also implies that the majority of pregnant women would experience pelvic instability which is not the case.

Moreover, the human genome encodes two biologically and immunologically active relaxin hormones –hRLX-1 and hRLX-2 [16 & 28] but all the studies reviewed have examined the effects of hRLX-2. Hence the possible role for hRLX-1 in human pelvic girdle relaxation remains uncertain.

The studies reviewed aimed at identifying, in most cases, the effect of relaxin on "back pain" in pregnancy. The majority of the studies failed to carry out a thorough classification of lumbar pain and the potential of its involvement. This has made it difficult to evaluate the effect of endocrine changes in the etiology of lumbar pain specifically. However acknowledging the limitations to these studies may encourage further research into this concept.

Predisposing Factors for LBP

Predisposing factors were covered in this review, since as the name implies they predispose or increase the likelihood to back pain in pregnancy. An insight into these factors may aid in the understanding of back pain, in particular lumbar pain in pregnancy. Age, previous history of back pain and type of work are three predisposing factors chosen for this review as they are variables that seem to have a greater influence on the lumbar spine rather than the pelvic joints.

Age

One of the earlier studies that looked at the predisposing factors of back pain in pregnancy was the study by Nwuga [21] in 1982. The prospective study (N=99) which investigated back pain among upper class Nigerian women found that increased age of the pregnant women (mean age was 26.4 years old) appeared to be associated with an increase in back pain during pregnancy. Statistical analysis carried out in this study was not extensive and the results were not tested for sensitivity or reliability (e.g. the use of Mann-Whitney U test), which is a limitation to the study. The study did not differentiate between lumbar or pelvic pain however in the explanation concerning their findings, the association between age and pain was attributed to increased degenerative changes in the spine as a result of the aging process. The study by Nwuga [21] was the only study in this review which found a positive linear association between age and onset of back pain during pregnancy.

Two studies by Ostgaard et al [23 & 24] which reviewed age and its association with back pain in pregnancy were published in 1991. These were large prospective studies with very high statistical power (N= 855, 804) and comprehensive statistical analysis. In both studies young age (classified as less than 29 years of age) was found to be a risk factor for back pain, that is, the younger the patient the greater the risk of back pain [$p<0.0001$ [24], $p<0.001$ [23]]. When age was related to intensity, a statistically significant relation was found between young age and pain intensity during the initial period of pregnancy ($p<0.05$). In an attempt to explain this finding Ostgaard et al [23] speculated that younger women may be more sensitive to hormonal changes of relaxin and estrogen, and have more pronounced collagen laxity.

In a smaller cohort study of 200 pregnant women representative of the basic population of the area, Kristiansson et al [12] found a significant negative correlation between pain intensity and age ($P<0.05$) concluding that younger women reported more pain than older women.

In the retrospective, representative population-based survey of women aged 15 years and older, Stapleton et al [31] multivariate analysis of age demonstrated a significant trend for older women to recall the least prevalence of back pain in pregnancy (95% CI 0.5 (0.3-0.8) $P<0.01$) and young women the most (95% CI 1.0). Even though the study is likely to have a high statistical power due to its large population number (n=1530), retrospective assessment may risk inconsistency by way of recall bias. This is supported by the study by Schmolck et al[30] which found that recollections just after 32 months were frequently inaccurate. In an age group that ranged from 15 years to 93 years, it is likely that the younger women (aged 15-34) were able to recall pain during a resent pregnancy compared to their older counterparts, who may have experienced pregnancy many years back. The validity of the findings was inconclusive as a result.

Unlike previous studies Orvieto et al [22] and Fast et al [8] did not find age to be risk factor for LBP during pregnancy. In the study by Fast [8] this finding was confirmed using a Mann-Whitney U test which supported the non existence of any significant difference between the two groups (pain vs. no pain) with regard to the age variable.

In general, more studies tend to recognize age as a risk factor; these studies are also more recent and have used validated methodology to reach their conclusion. A definite explanation of why this is the case requires more research highlighting once more the lack of knowledge in this field.

Previous history of LBP

Berg et al [3] demonstrated in a prospective study that women with a history of lower back pain in a previous pregnancy had an increased risk of developing SIJ dysfunction during the present pregnancy ($P<0.01$). In a follow up study 12 years later, Brynhildsen et al [6] sent 62 questionnaires to the same women who took part in Berg [3] original study. In this study almost all women (31 of 33, 94%) with previous disabling low back pain during the pregnancy also developed low back pain during the subsequent pregnancy [6, 8].

Using a logistic regression with backward elimination, previous LBP during pregnancy was identified as the only independent risk factor for LBP during pregnancy.

In a large scale study by Ostgaard et al [23] where the total population (N=804) represented 90% of all pregnancies at that particular time, the most significant finding was that previous back pain was a strong risk factor not only with respect to the occurrence of back pain but also with respect to back pain intensity and the duration of back pain in a future pregnancy [23, 24]. The data was analyzed statistically using the X_2 method, comparison of means and the Pitman correlation test. The prospective study also calculated the risk for a woman who has had back pain in the past to have back pain in her next pregnancy, in this study it was found to be 2.09 times higher for a woman who has had back pain in the past.

Finally, Orvieto at el [22] also supported the previous findings by Ostgaard [23, 24]. A factor which was found in this prospective study to be associated with an increased risk to develop LBP during pregnancy was existence of LBP by the first pregnancy (P<0.003), during previous pregnancy (P<0.005) and between pregnancies (P<0.001).

Throughout this review, there was no study that found a negative, or no correlation between a history of back pain and back pain in pregnancy. The studies that looked at this variable all identified a history of back pain as a strong risk factor for back pain in future pregnancies. Unfortunately although pain drawings were used in some of these studies; lumbar pain was not specifically identified, back pain was not classified.

Work

Berg et al [3] observed that 2/3 of the women who eventually developed SIJ dysfunction stated that their work involved lifting and simultaneous turning movements, whereas this type of work was less common (1/3) among women without low back pain (P<0.05).

Using logistic regression with backward elimination, Brynhildsen et al [6] found the combination of previous LBP and moderate or heavy occupation increased the risk for current LBP (P<0.05 & P<0.005, respectively) although the occupational situation alone did not influence the risk for a new episode of low back pain in a forthcoming pregnancy. A limitation to Brynhildsen [6] study was the retrospective design.

Recollection of information from the past 12 years and the fact that the occupational situations as well as reports of the pain were self estimated could have resulted in biased data.

Findings of the study by Orvieto et al [22] show a higher incidence of LBP during pregnancy in relatively lower socioeconomic class. The study speculated that women in this socioeconomic class are exposed to more strenuous physical work as repetitive lifting and bending which, as supported by previous studies are activities which are risk factors to LBP [3, 6, 24]. The study by Fast et al [8] also looked at socioeconomic status as a variable in back pain during pregnancy, however this study failed to identify and describe the type of work carried out by the pregnant sample group. Furthermore none of these studies specifically classified lumbar pain.

Finally the conclusion for the prospective study (N=855) by Ostgaard et al [24] stated that physically heavy work, lifting, twisting, forward bending, poor work satisfaction, post work fatigue, inability to take breaks and constrained working postures were vocational factors associated with an increased complaints of back pain during pregnancy. Although pain was classified into three groups (high back, low back and sacroiliac pain), the concluded findings were not related back to the classification system previously described.

These studies confirm that the type of work can be a risk factor for lower back pain during pregnancy. These can be used to encourage back safe and ergonomic education in the work place as a preventative measure for lower back pain in pregnancy.

Discussion

In comparison to the research available on back pain during pregnancy, studies that have focused particularly on lumbar pain are few. More studies however are now identifying and distinguishing between the subgroups of back pain than had been previously categorized under the same broad concept of "back pain". Therefore this review was only as specific to lumbar pain as allowed by the more recent process of classification.

The information available so far fails to provide a specific explanation for the cause of lumbar pain in pregnancy. The majority of literature tends to incline towards two possible causes, that is, postural or endocrine in nature. Lumbar back pain however, cannot be solely attributed to these changes. In regards to postural changes, a number or studies confirm that during pregnancy these changes do certainly occur. However, what is worth noting from these findings is that apart from saggital and tranverse diameter and thoracic kyphoses everything else, including lumbar lordosis, pelvic tilt, head posture and also weight gain do not correlate to lower back pain. If postural changes were to be a specific cause of back pain in pregnancy, it would be expected that a direct relationship between these changes and gestational age would be apparent as these changes become more prominent as the pregnancy progresses.

In regards to endocrine changes, data from various studies are contradictive. There are long-standing as well as more recent studies that disagree on the role of serum relaxin and its association with lower back and pelvic pain in pregnancy. A critical analysis of the methodology and validity of these studies however, suggests that during human pregnancy serum relaxin does not play a role in pelvic pain. Furthermore, a pain-producing role of relaxin would imply that pregnant women in general, will undoubtedly suffer from back and/or pelvic pain during every single pregnancy, which is not the case. Additional research is required to determine the exact relationship between relaxin levels and predisposition to lumbar pain. Moreover further study is required for the second type of relaxin, hRLX-1 and its possible implication in lumbar and pelvic pain during pregnancy.

Taken together, the studies reviewed have provided a better understanding of endocrine and postural changes. However it is important to take into account that these studies have proposed causes of back pain but have failed to provide a direct cause and effect relationship between the two.

Predisposing factors were included in this review in an attempt to identify an association between these and the cause of lumbar pain. Age, previous back pain and type of work were variables chosen in particular, as these may be considered to have a link to LBP rather than pelvic pain. However a common limitation found in the studies that investigated these variables was failure to distinct lumbar from pelvic pain. That is, the use of a classification system that would allow a clear distinction between these two types of pain. All these factors were associated with back pain, especially an existing history of back pain, which was found in all the relevant studies to be a strong predictor of lower back pain in pregnancy. Although these variables (age the least) may appear to affect the lumbar region to a greater extent, one can only speculate that this is the case. Comprehensive classification of the types of pain, may eventually confirm this hypothesis, a lack of this methodology was a limitation to this review.

Conclusions

The literature reviewed provided conflicting data regarding the role of postural and endocrine changes in lumbar pain. However, the studies were beginning to develop a classification system whereby the different types of back pain can be classified. This was lacking in the earlier studies where lumbar pain was not identified hence making it difficult to address and understand its etiology. It is also important to consider predisposing factors as they may play a role in preventing lower back pain in pregnancy. Due to the existing high incidence of LBP, research is essential not only to acquire a greater insight to the etiology of lumbar pain but also to provide treatment for pregnant women.

References

1. Albert H, Godskesen M, Westergaard J. Evaluation of Clinical tests used in classification procedures in pregnancy-related pelvic joint pain. European Spine Journal. 2000; 9: 161-166.
2. Bates Barbara (1995) A guide to Physical Examination and History Taking. 6th Edition. J.B. Lippincott Company.
3. Berg G, Hammar M, Moller-Nielsen J, Linden U & Thorblad J. Low Back Pain during Pregnancy. Obstetrics and Gynecology. 1988; 71(1): 71-75.
4. Bjorklund K, Bergstrom S, Nortstrom M-L & Ulmsten U. Symphyseal distention in relation to serum relaxin levels and pelvin pain in pregnancy. Acta Obstetricia et Gynecologica Scandinavica. 2000; 79: 269-275.
5. Bjorklund K, Nortstrom M-L & Odlind V. Combined oral contraceptives do not increase the risk of back and pelvic pain during pregnancy or after delivery. Acta Obstetricia et Gynecologica Scandinavica. 2000; 79: 979-983.
6. Brynhildsen J, Hansson A, Persson A & Hammar M. Follow-Up of Patients with Low Back Pain during Pregnancy. Obstetrics and Gynecology.1998; 91(2): 182-186.
7. Bullock J, Jull G & Bullock M. The Relationship of Low Back Pain to Postural Changes During Pregnancy. The Australian Journal of Physiotherapy. 1987; 33(1): 10-17.
8. Fast A, Shapiro D, Ducommun E, Friedmann L, Bouklas T & Floman Y. Low-back Pain in Pregnancy. Spine. 1987; 12(4): 368-371.
9. Franklin M & Conner-Kerr T. An Analysis of Posture and Back Pain in the First and Third Trimesters of Pregnancy. Journal of Orthopaedic & Sports Physical Therapy. 1998; 28(3): 133-138.
10. Hansen, A. Jensen D.J. Larsen, E. Wilken-Jensen, C. & Petersen, K. Relaxin is not related to symptom-giving pelvic girdle relaxation in pregnant women. Acta Obstetricia et Gynecologica Scandinavica. 1996; 75: 245-249.

11. Kristiansson P & Svardsudd K. Discriminatory Power of Tests Applied in Back Pain During Pregnancy. Spine. 1996; 21:2337-2343.

12. Kristiansson P, Svardsudd K & Schoultz B. Back Pain during Pregnancy: A Prospective Study. Spine. 1996; 21(6): 702-709.

13. Kristiansson P. Svardsudd K & Schoultz B. Serum relaxin, symphyseal pain, and back pain during pregnancy. American Journal of Obstetrics and Gynecology. 1996; 175 (5):1342-1347.

14. LaBan, M. Perrin, J. & Latimer, F. Pregnancy and the Herniated Lumbar disc. Archives of Physical Medicine and Rehabilitation. 1983; 64: 319-321.

15. Lindal E, Hauksson A, Arnardottir S & Hallgrimsson J. Low back pain, smoking and employment during pregnancy and after delivery – a 3-month follow up study. Journal of Obstetrics and Gynaecology. 2000; 20(3): 263-266.

16. MacLennan A.H. The Role of the Hormone Relaxin in Human Reproduction and Pelvic Girdle Relaxin. Scand J Rheumatology. 1991; Supplement 88: 7-15.

17. MacLennan A, Nicolson R, Green R & Bath M. Serum Relaxin and Pelvic Pain of Pregnancy. The Lancet. 1986; 2(8501): 243-5.

18. Murtagh J (2003) General Practice. 3rd Ed. McGraw-Hill Australia Pty Ltd.

19. Noren L, Ostgaard S, Johansson G & Ostgaard H. Lumbar back and posterior pelvic pain during pregnancy: a 3 year follow up. European Spine Journal. 2002; 11:267-271.

20. Noren L, Ostgaard S, Nielsen T & Ostgaard H. Reduction of Sick Leave for Lumbar Back and Posterior Pelvic Pain in Pregnancy. Spine. 1997; 22(18): 2157-2160.

21. Nwuga V. Pregnancy and Back Pain among Upper Class Nigerian Women. The Australian Journal of Physiotherapy. 1982; 28(4): 8-11.

22. Orvieto R, Achiron A, Ben-Rafael, Gelernter I & Achiron R. Low Back Pain of Pregnancy. Acta Obstetricia et Gynecologica Scandinavica. 1994; 73: 209-214.

23. Ostgaard H & Andersson G. Previous Back Pain and Risk of Developing Back Pain in a Future Pregnancy. Spine. 1991; 16(4): 432-436.

24. Ostgaard H, Andersson G & Karlsson K. Prevalence of Back Pain in Pregnancy. Spine. 1991; 16(5): 549-552.

25. Ostgaard H, Andersson G, Schultz A & Miller A. Influence of Some Biomechanical Factors on Low-Back Pain in Pregnancy. Spine. 1993; 18(1): 61-65.

26. Ostgaard H, Zetherstrom G, Roos-Hansson E & Svanberg B. Reduction of Back Pain and Posterior Pelvic Pain in Pregnancy. Spine. 1994; (19)8: 894-900.

27. Petersen L, Vogel I, Agger A, Westergard J, Nils M & Uldbjerg N. Variations in serum relaxin (Hrlx2) concentrations during human pregnancy. Acta Obstetricia et Gynecologica Scandinavica. 1995; 72: 251-256.

28. Petersen L, Hvidman L & Uldjerg N. Normal Serum Relaxin in Women with Disabling Pelvic Pain during Pregnancy. Gynecological Obstetric Investigation. 1994; 38:21-23.

29. Requejo S, Barnes R, Kornelia K, Robert L & Gonzales S. The Use of Modified Classification System in the Treatment of Low Back Pain during Pregnancy: A Case Report. Journal of Orthopaedic & Sports Physical Therapy. 2002; 32(7): 318-325.

30. Schmolck H., Buffalo E.A., & Squire L.R. Memory Distortions Develop Over Time: Recollections of the O.J. Simpson Trial Verdict after 15 and 32 Months. Psychological Science. 2000; 11(1): 39-45.

31. Stapleton D, MacLennan A & Kristiansson P. The prevalence of recalled low back pain during and after pregnancy: a South Australian population survey. Australia & NZ Journal of Obstetrics & Gynecology. 2002; 42(5): 482-485.

32. Svensson H, Andersson G, Hagstad A & Jansson P. The Relationship of Low-Back pain to Pregnancy and Gynecologic Factors. Spine. 1990; 15(5): 371-375.

33. Wedenberg K, Moen B & Norling A. A prospective randomized study comparing acupuncture with physiotherapy for low-back and pelvic pain in pregnancy. Acta Obstetricia et Gynecologica Scandinavica. 2000; 79: 331-335.

34. Wreje U, Kristiansson P, Aberg H, Bystrom B & Schoultz B. Serum Levels of Relaxin during the Menstrual Cycle and Oral Contraceptive Use. Gynecology and Obstetrics Investigations. 1995; 39: 197-200.

Appendix (i) Definition of Lumbar and Pelvic Pain

Author	Lumbar back pain	Pelvic pain
Berg et al 1988	(the term muscular insufficiency is used to describe back pain) Tiredness, discomfort or pain is experienced upon movement. The back feels week and stiff. The range of motion is normal and there are no neurologic or root tension signs.	(Described as SIJ Dysfunction) Pain at provocation testing and/or a disturbed motion of the SIJ at functional testing (Patrick's, Derbolowski's & SIJ fixation tests)
Lindal et al	Any pain in the low back irrespective of the specific cause of pain.	
Noren et al 2002	Present earlier in life Pain in the lumbar back Reduced motion in lumbar back Pain on palpation of back muscles Little problem walking or standing Constant pain Negative provocation test for pelvic pain	- New type of pain, debut during pregnancy - Time and weight bearing related pain in the posterior pelvis, deep in one or both gluteal areas. - Normal motion in lumbar back. - Pain in palpation in the gluteal area. - Pain when walking or standing. - Pain free intervals. - Positive provocation test for pelvic pain.
Orvieto et al 1994	All conditions of pain, ache, stiffness or fatigue localized to the lower back.	
Ostgaard et al 1994	Back pain as pain from the lumbar area only with or without radiations to the legs.	- A history of time and weight bearing related pain in the posterior pelvis, deep in the gluteal area. - A pain drawing with well-defined markings of stabbing in the buttocks distal and lateral to the L5-S1 area, with or without radiation to the posterior thigh or knee, but not into the foot. - A positive "posterior pelvic pain provocation test". - Free movements in the hips and spine and no nerve root syndrome. - Pain when turning in bed.
Svensson et al 1990	LBP was defined as all conditions of pain, ache, stiffness or fatigue localized to the lower back.	

Appendix (ii) Submission to Journal

1.1 Title page (page 1)

Etiology of Lumbar Pain in Pregnancy

1.2 Abstract (page 2)

1.3 Text (starting page 3)

1.4 Summary

Lower back pain in pregnancy is very common and at the same time is a complaint that has been scarcely researched. This literature review critically analyzes part of the present research on back pain in pregnancy, with a specific focus on lumbar pain and its etiology. The cause of lumbar pain has been mainly attributed to either postural or endocrine changes. The literature available remains conflicting and suggestive of a complex cause of lumbar pain that may be multifactorial in nature. The literature also emphasizes the need for further research into this field. Age, previous history of back pain and the type of work are risk factors for lower back pain in pregnancy.

1.5 10 quiz questions based on material in the manuscript

1. The average percentage of women that experience back pain in pregnancy is:

a) 50% b) 62.5% c) 89%

2. It is essentially important to distinguish lumbar pain from:

a) Posterior pelvic pain b) thoracic pain c) Hip joint pain

3. Lumbar pain is classified as:

a) Pain arising from lumbar spine b) pain present on weight bearing c) pain on SLR

4. Significant correlation between _____ and back pain has been found in the current research.

a) Lumbar lordosis b) thoracic kyphosis c) symphyseal distention

5. Relaxin:

a) Regulates collagen b) strengthens ligaments c) reduces laxity

6. Age is a predisposing factor for back pain in pregnancy. Which age group would be more likely to complaint from back pain during their pregnancy?

a) 15-25 b) 26-35 c) 36 +

7. What type of work predisposes women to lower back pain in pregnancy?

a) Heavy + lifting involved b) physically active c) mentally demanding

8. Which of the predisposing factors reviewed was more strongly correlated to lower back pain in pregnancy.

a) Age b) previous history of back pain c) type of work

9. The specific cause of lumbar pain during pregnancy is:

a) Postural change b) endocrine change c) still unknown

10. Based on this literature review, research in this field is:

a) Substantial b) enough c) scarce

1.6 Answers to Quiz

1. b
2. a
3. a
4. b
5. a
6. a
7. a
8. b
9. c
10. c

1.7 References (starting page 20)

1.8 Tables (appendix (i))

1.9 Permission

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February 17th, 2004

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RE: Memorandum of Transmission Form

I Wendy Rodriguez hereby give the Australasian Chiropractic & Osteopathy Journal copyright and publishing rights for the literature review titled "Etiology of Lumbar Pain in Pregnancy"

Wendy Rodriguez

1.10 Acknowledgements (page 30)

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