Applying the Sports Nutrition Model to Pregnancy

Ian Craig

At first glance, drawing any equivalence between sports and pregnancy might seem a bit of a stretch. There are, however, many metabolic and nutritional needs that increase in a pregnant woman that may be mirrored in the regular exerciser. So, what can we learn from the field of sports nutrition that could benefit a mother-to-be?

Energetic Increase
If the full-term infant weighs 3-4 kg, together with supporting tissues (uterus, placenta and amniotic fluid), the average pregnant woman will gain at least 6.5 kg during her pregnancy. Based on such calculations, The Food and Agriculture Organization, World Health Organization and United Nations University recommends an additional 1200 kJ/day (285 Cal*/day) for the entire pregnancy. This is a rather simplistic recommendation because each woman will have different metabolic needs and will gain different amounts of weight. It has even been observed that in mothers who are not in a position to eat any more (perhaps in an impoverished society), their own basal metabolic rate (BMR) will decrease in order to offer nutritional resources to the foetus.

Nonetheless, the average pregnant woman will need to bolster her eating compared to the pre-conceptual period. If you take the regular habitual exerciser who trains for 30 mins every day, you are probably looking at about the same increase in calories. For example: a 60 kg person running at a steady 8 min/mile pace will require about 390 Cals; doing aerobic dancing for the same time will require about 240 Cals and swimming breast stroke will require about 300 Cals. These figures are similar to the recommendations for pregnancy.

Nutritional Therapy tends to focus on quality of food more than quantity and that is entirely appropriate to ensure that the pregnant woman is consuming really nutrient-dense food. It is also pertinent to take a leaf out of the dietician’s book and look at quantities of food consumed. As noted when discussing energy needs, ensuring sufficient macronutrient intakes during pregnancy is important for the mother and child – this may be particularly important to consider if there has been any history of disordered eating patterns. On-line entries of meals consumed can make this job very easy for us.

Insulin Sensitivity
Blood sugar regulation is a regular part of the Nutritional Therapist’s armoury and the needs of exercise and pregnancy are no different. During a normal pregnancy, a series of hormonal events contributes to insulin resistance at the muscle cells, ensuring an adequate glucose supply for foetal growth and development. If the woman has risk factors for Gestational Diabetes such as obesity, pregnancy might just push the blood glucose and insulin levels too high. So focus on blood sugar control during pregnancy is even more important to maintain a steady blood glucose supply to the mother and foetus. The same situation can be seen acutely soon after exercise. As shown in Diagram 1, if the appropriate post-exercise nutrition is not consumed within about an hour of exercise completion, the person may go into a period of insulin resistance. Ivy and Portman have made an important contribution to the sports nutrition field with their discussions of Nutrient Timing.

**Figure 1**: Nutrient Timing & Insulin Resistance taken from Nutrient Timing by Ivy & Portman

The message for the pregnant woman, just like the sports person, is to consume meals and snacks in a ‘little and often’ fashion; being aware of the Glycaemic Index of carbohydrates consumed and to include some quality protein each time.

Additionally, as shown in Figure 1, if nutrient timing guidelines are adhered to, exercise has a great potential for insulin sensitivity. Acute and chronic exercise training has been shown to increase insulin sensitivity in a way that blunted the insulin response to a glucose load despite subjects having lower blood glucose levels than in the sedentary state. 10 days of rest in endurance-trained subjects doubled the insulin response to 100g oral glucose and also increased blood glucose concentrations, suggesting a more insulin-resistant state. These changes were almost reversed by one training bout on Day 11. Exercising with caution during pregnancy has been advocated for many reasons by the American College of Sports Medicine.

**Protein**

It has been estimated that protein needs increase during pregnancy by an average of 10% (less in the 1st trimester and more in the 2nd and 3rd). The additional protein is needed for expansion of the blood volume, uterus, breasts and foetal and placental tissues. Dietary surveys in developed countries even indicate that pregnant women on self-selected diets generally consume somewhat larger amounts of protein than their requirements calculated theoretically. Moreover, satisfactory intakes of protein tend to be associated with improved reproductive outcome.

Likewise, protein needs have been estimated to increase from 0.8-1.0 grams per kilogram per day (g/kg/day) for sedentary individuals to about 1.2 g/kg/day in moderately exercising endurance athletes and to about 1.5-1.7 g/kg/day during early-phase resistance training. The 10% rise in
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pregnancy would be close to the needs of the individual undertaking low-moderate volume endurance exercise.

Like the exerciser, therefore, the pregnant woman would benefit from ensuring that there is some quality protein in each meal and snack consumed. Table 1 shows possible sources of 20g of protein – a 60kg pregnant woman who needs to consume around 1.0 g/kg/day of protein would require 60+g per day. If she consumed 15+g in each meal and 10g in two snacks, she would meet her target. As shown in the table, animal-based protein sources are more protein-dense than vegan options, so pregnant women who choose to be vegan need to pay particular attention to protein intake. An option that is particularly popular within sporting populations is protein powder – available options are whey, casein, soya, rice and pea. The pregnant woman might consider such a powder to more easily reach her protein needs, especially if experiencing periods of nausea when solid food is not so appealing.

Table 1 – Food that will provide 20g protein, taken from Training Peaks

<table>
<thead>
<tr>
<th>Food</th>
<th>Quantity for 20g Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey Breast</td>
<td>61g</td>
</tr>
<tr>
<td>Chicken Breast</td>
<td>62g</td>
</tr>
<tr>
<td>Beef Fillet Steak</td>
<td>70g</td>
</tr>
<tr>
<td>Canned Tuna</td>
<td>83g</td>
</tr>
<tr>
<td>Salmon, Grilled</td>
<td>83g</td>
</tr>
<tr>
<td>Eggs</td>
<td>3 whole eggs</td>
</tr>
<tr>
<td>Cottage Cheese</td>
<td>154g</td>
</tr>
<tr>
<td>Milk</td>
<td>571ml</td>
</tr>
<tr>
<td>Fromage Frais</td>
<td>400g</td>
</tr>
<tr>
<td>Natural Yoghurt</td>
<td>417g</td>
</tr>
<tr>
<td>Peanut Butter</td>
<td>5 tbsp</td>
</tr>
<tr>
<td>Pumpkin Seeds</td>
<td>6 tbsp</td>
</tr>
<tr>
<td>Cashew Nuts</td>
<td>100 nuts</td>
</tr>
<tr>
<td>Quorn Mince</td>
<td>170g (7 tbsp)</td>
</tr>
<tr>
<td>Hummus</td>
<td>240g (1 large pack)</td>
</tr>
<tr>
<td>Tofu</td>
<td>250g (1 pack)</td>
</tr>
<tr>
<td>Soy Burger</td>
<td>240g (~4 burgers)</td>
</tr>
<tr>
<td>Baked Beans</td>
<td>400g (1 large tin)</td>
</tr>
<tr>
<td>Wholemeal Bread</td>
<td>217g (6 slices)</td>
</tr>
<tr>
<td>Pasta, boiled</td>
<td>285g</td>
</tr>
<tr>
<td>Brown Rice, boiled</td>
<td>670g</td>
</tr>
</tbody>
</table>

Having done the hypothetical calculations of protein needs in the pregnant woman, it is worth mentioning that in practice, individual needs can vary enormously. For example, some individuals will maintain excellent health on a vegan or vegetarian diet, whereas others are more suited to a higher-protein Paleo-style approach. Comparing protein intakes across these example diets becomes almost an academic exercise – what is more important is the overall health of the individual. This will apply whether we are discussing a pregnant woman, a sports person or a sedentary individual. Asking the individual to fill in the Metabolic Typing11 questionnaire might help to guide your clinical judgment, as will the Amino Acids Functional Testing.12

Antioxidants

During pregnancy, the degree of oxidative stress rises mostly due to the mitochondrial-rich placenta and this will peak during the 2nd trimester.13 Increased antioxidant reserves are required to protect the foetus during this time. Conditions that are found during pregnancy, such as pre-eclampsia and gestational diabetes have been associated with free radical damage.13 Another study has demonstrated that pregnancies which successfully reach term were associated with increased levels of superoxide dismutase (SOD) during the 1st trimester. Concurrently, miscarriage during the 1st trimester was associated with reduced levels of SOD and elevated oxidative stress.
Likewise, it has been recognised that exercise increases the oxidative load on the body - during muscular exercise, 3 to 5% of oxygen might end up as oxygen-centred radicals$^{15}$, potentially a lot of cellular damage during heavy exercise. However, like pregnancy, elevated antioxidant protection has been noted during chronic exercise training - a strong correlation has been noted between an individual's VO$_2$max score and levels of SOD.$^{16}$

So, when women become pregnant or undergo an exercise programme, their antioxidant activities increase. This statement will be true as long as the raw ingredients are available to support these elevated activities. SOD requires the cofactors manganese in the mitochondria and zinc and copper in the cytosol of the cell; glutathione peroxidase needs selenium; catalase needs iron; niacin is needed for the reduction of oxidized enzyme antioxidants back to their original form$^{15}$. Additionally, we must consider the Q-E-C (CoQ10, Vit E and Vit C) cycle, which is a crucial protectant of lipid membranes$^{15}$. Then there are the phytonutrient sources of antioxidants, such as lycopene in tomatoes, catechins in green tea and resveratrol in red grapes, plus many others that are being discovered.

So, in terms of antioxidants, to thrive, both the pregnant woman and the sports person require a nutrient-dense diet, rich in diversity. Supplemental support would also be pertinent at this time – in addition to the well-established recommendations for folic acid, there is some evidence that multi-nutrients used pre-conceptually have a certain protective effect on some pregnancy-related illnesses and birth defects, leading some organisations to support their use.$^{17}$

**Musculoskeletal Health**

According to the American College of Sports Medicine$^{6}$, most pregnant women experience some sort of musculoskeletal problem and 25% have symptoms that are temporarily disabling. Lower back pain and abdomino-pelvic problems seem to be most prevalent symptoms, although knee pain and carpal tunnel syndrome in the hands are also relatively common$^{6}$. Reasons include the increased weight of the baby that must now be supported – this can put biomechanical strain on the woman because the weight is specifically in the belly region and not evenly spread through the body. Additionally, laxity of ligaments due to hormonal influences can be a major contributor to joint-related pain towards the end of term.$^{6}$

In sport, each discipline has its own injury risks. Games sports like football and basketball may risk damage to the player's knees due to impact and rotational strains; endurance athletes like runners and cyclists may risk repetitive injuries such as shin splints, Achilles tendon and Iliotibial (IT) Band injuries. Biomechanics also play a large part in injury susceptibility and a common requirement of athletes and pregnant women is to regularly work on strengthening core stability.

Nutritionally, both population groups can support themselves during times of increased musculoskeletal stress. An excellent paper by Perry$^{18}$ discusses the groups of nutrients that can be beneficial for prevention plus rehabilitation of acute and chronic injuries or musculoskeletal imbalances. Suggested options include:

- **Pain management:** anti-inflammatory herbs, glucosamine and chondroitin
- **Anti-inflammation:** herbs plus omega 3 and 6 essential oils
- **Range of motion:** niacin and N-acetyl cysteine
- **Swelling:** proteolytic enzymes
- **Muscle relaxation:** magnesium, calcium and relaxing herbs
- **Tissue protection:** antioxidants
- **Collagen rebuilding:** proline, lysine, alpha-ketoglutarate and Vitamin C

(It must be mentioned here that of course any use of herbs during pregnancy must only be done with the supervision of a qualified herbalist.)

**Other Common Requirements of Pregnancy and Exercise**

It should be obvious by now that pregnancy and exercise was not such a daft assimilation to try and make. Other considerations that are relevant to both scenarios, that have not been addressed in this...
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article are: essential fatty acids needs; immune stability; body composition and eating disorders and also B-vitamin and methylation needs. For example, amino acid metabolism, which is heavily upregulated during high-intensity high-volume exercise, is dependent on vitamin B6 in its pyridoxal-5-phosphate form;19 conduction of nervous tissue and therefore muscular contraction requires Vitamin B6, B12 and folic acid;20; adrenal glands utilise vitamin B6 and are called into action more frequently during exercise training programmes. If we add into the equation the challenges in some athletes of compromised gastrointestinal function which might compromise vitamin B12 absorption, the parallels with pregnancy can be continued. I am sure that we can probably think of a few more too.

* Cals is used as an abbreviation for Kcals throughout.

References


