1 Nutrition and Fertility

Summary

Although genetic and medical conditions may both be common causes of infertility (and subfertility), research shows that certain dietary factors may also affect the chances of conceiving. Over the last few decades, a growing body of literature has been published in this area. There is some evidence to suggest that high alcohol and caffeine intakes and low intakes of antioxidants may be associated with reduced fertility. Equally, both ends of the energy spectrum (under- and overnutrition) appear to have an unfavourable impact on fertility status. For individuals who are overweight or obese, achieving a healthy body weight may help to improve both fertility and the success of reproductive treatments. Overall, simple lifestyle changes such as monitoring alcohol and caffeine intakes and obtaining a healthy body weight are a good start to any pregnancy, as well as helping to improve fertility levels. Imparting these messages to men and women in their childbearing years may help to reduce time to conception and is always worth trying before seeking fertility treatments, which can sometimes be expensive. For those undergoing assisted reproductive technologies, dietary advice may also be effective alongside these treatments when couples are having difficulties conceiving.

Learning Outcomes

- To understand how dietary factors may affect the fertility of both men and women in their childbearing years.
- To be aware of the importance of a healthy body weight when planning a pregnancy, or undergoing assisted reproductive technologies (ARTs).
- To appreciate that simple dietary and lifestyle changes may help to support couples when planning a pregnancy or undergoing reproductive treatments.

1.1 Introduction

Data show that infertility rates are rising, as demonstrated by the rise in fertility treatments such as in vitro fertilisation (IVF) in recent years (HFEA, 2010). There is no doubt that the causes of infertility are multifaceted with older childbearing age, medical and health complications being some underpinning causes. Even though ARTs may go some way towards helping couples conceive, emerging evidence...
suggests that dietary advice may also have an important role to play. For both men and women, there is a strong link between energy balance and reproductive function. In both developed and developing regions, rising body weights are being linked to reduced fertility levels. Although slowly, scientists are starting to uncover how individual dietary components may influence fertility levels. However, this research needs to continue and certainly more carefully designed randomised controlled trials are needed.

Carrying out research during this phase of the life cycle can be difficult for several reasons. Couples planning to have a baby are a difficult population to access, researching time to conception can be stressful for couples and testing the efficacy of dietary interventions can be difficult if patients are already getting reproductive treatments. This chapter has been divided into two sections: the first focusing on nutrition and female fertility and the second part male fertility. The chapter begins by defining the term ‘infertility’ and related definitions. The role of energy balance, obtaining a healthy body weight and specific nutrients and how these can affect both male and female fertility is then described. Finally, recommendations and guidelines for application in practice will be provided at the end of each section for females and males.

1.2 Nutrition and female fertility

1.2.1 Defining fertility

Fertility, sometimes referred to as fecundity, is the ability to reproduce and conceive naturally. Some couples can get pregnant very easily, but for others, this can take significantly longer than anticipated. The term ‘subfertility’ is often used to describe any form of reduced fertility and prolonged time to conception (Gnoth et al., 2005). It is estimated that around 10–15% of couples in industrially developed countries have difficulty with conceiving. When conception fails to precede after 12 months or more of regular, unprotected intercourse, the term ‘infertility’ is used. For women aged 35 years and over, earlier treatment may be justified when pregnancy has not been achieved after 6 months (American Society for Reproductive Medicine, 2008). There are many different causes underlying fertility problems. These may be genetic, age-related, caused by hormone imbalances or medical problems such as polycystic ovary syndrome (PCOS), as well as dietary and lifestyle factors.

1.2.2 Other definitions

The term ‘fertility’ is broad and within this there are various subcategories of fertility. We have already defined infertility and subfertility; however, couples may also be defined within primary or secondary infertility, depending on whether a pregnancy has been achieved previously (Table 1.1). Ovulatory infertility accounts for around 30% infertility means that the female partner is having trouble conceiving. Irregular patterns of menstruation (oligomenorrhoea) or the absence of menstrual cycles can be contributing factors, as well as medical conditions such as PCOS (Hamilton-Fairley and Taylor, 2003). When the male partner has reproductive problems, i.e. reduced
Table 1.1 Subcategories of fertility.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infertility</td>
<td>When pregnancy does not occur, usually after 12 months of unprotected intercourse</td>
</tr>
<tr>
<td>Subfertility</td>
<td>When it takes much longer than anticipated to achieve a pregnancy</td>
</tr>
<tr>
<td>Primary infertility</td>
<td>When neither partner has achieved a pregnancy previously after having unprotected intercourse</td>
</tr>
<tr>
<td>Secondary infertility</td>
<td>When pregnancy has been achieved previously but a second pregnancy is not achieved after 12 months of unprotected intercourse</td>
</tr>
<tr>
<td>Ovulatory infertility</td>
<td>When couples are unable to conceive because the female has a reproductive problem (usually with ovulation)</td>
</tr>
<tr>
<td>Male factor infertility</td>
<td>When couples are unable to conceive because of a problem with the male reproductive system</td>
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</table>

sperm motility or numbers that can reduce the chances of conception, scientists and doctors usually refer to this as male factor fertility.

### Getting Started  Defining the childbearing years

Before discussing the issues around infertility, it is important to attempt to define what may be described as the 'childbearing years', indeed no easy task. Although very distinct age ranges (usually around 16–40 years) have been used in studies, there are always exceptional circumstances!

Falling pregnant too early, or too late, in life can mean that both the diet needs to be tailored and women carefully monitored throughout their pregnancies. Early adolescent childbearing has been defined as 15 years or younger, as the risk of infant mortality, very preterm (born before 32 weeks) and very low birth weight infant deliveries (<1500 g) is higher amongst girls in this age category, stabilising at around age 16 (Phipps and Sowers, 2002).

Equally, more women are also leaving pregnancy until later on in their childbearing years. This is particularly the case in Britain, which has some of the highest birth rates for older women in the world. With advances in fertility treatment and oocyte donation becoming increasingly available, it is not uncommon for women in their 50s, or even the sixth decade of life to fall pregnant (sometimes referred to as advanced reproductive age). These women may also have a higher risk of developing pregnancy complications such as pre-eclampsia, gestational diabetes mellitus and delivering by c-section (Chibber, 2005).

### 1.2.3 Maternal age

It is well known that the ability to conceive and carry a baby until term declines with age. Pregnancy rates become lower once women reach their mid-thirties and are reduced even further once a woman reaches her forties. Scientists have found that
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Table 1.2 How ovarian age can be measured.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Explanation</th>
</tr>
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<tbody>
<tr>
<td>Antral follicle count (AFC)</td>
<td>The AFC is the number of follicles remaining on the ovaries and a good indicator of the number of eggs than can be produced. Doctors can normally count the number of follicles remaining using ultrasound technology.</td>
</tr>
<tr>
<td>Levels of follicle stimulating hormone (FSH)</td>
<td>This is the main hormone involved in producing mature eggs in the ovaries. Both high and low levels can reduce fertility. FSH can be measured easily from blood tests.</td>
</tr>
<tr>
<td>Inhibin B</td>
<td>A protein hormone produced by the ovarian follicles. The amount produced is an indicator of the number of eggs in the ovaries, i.e. when secreted at lower levels, this indicates that a woman’s egg reserves are low. Once again, inhibin B levels can be derived from blood tests.</td>
</tr>
</tbody>
</table>

the number of ova (eggs) and quality of eggs are both reduced as women get older. Women’s eggs need to have the right chromosomes and be able to form a viable embryo. With age, the shape of eggs may change and the thickness of their walls becomes thinner. This means that older women not only have reduced fertility levels, but the risk of birth defects and miscarriage is also higher in this group (American Society for Reproductive Medicine, 2002).

On a more positive note, studies have shown that a woman’s chronological age does not necessarily determine her ovarian age, sometime referred to as ‘ovarian reserve’ (the number of eggs remaining in the ovaries). Sometimes, older women may have better quality eggs than younger women, which is where dietary and lifestyle practices may come into play. Scientists have shown that levels of inhibin B (a marker of ovarian ageing; Table 1.2) are lower in women who smoke i.e. ovarian age is more advanced (Waylen et al., 2010). Subjectively, it is also important that such studies control for coital frequency when concluding their findings, as this too decreases with age (Klein and Sauer, 2001) and may affect the results of studies. More research is now needed to study the role of dietary and lifestyle factors and the effect these may have on women’s ovarian age. Other markers of ovarian ageing, often used by scientists and researchers, are shown in Table 1.2.

1.2.4 Undernutrition

Reproduction is a costly process requiring significant amounts of energy. When energy intake and expenditure are not in balance, ovulation may be suppressed. There are several theories linking undernutrition to reduced reproductive potential. More than 30 years ago, Rose Frisch, now a Professor at Harvard School of Public Health, was one of the first scientists to link low body weight and fat stores to amenorrhea and reduced fertility. The theory behind this was that a certain level of body fat was needed to convert androgen hormones to oestrogens, hormones needed for female reproductive function. In turn, the potency of these hormones was also thought to be related directly to body weight and fat (Frisch, 1987). Although the science behind this theory still stands, the role of oestrogens in reproductive function is not as vast as once thought.
Figure 1.1 Implications of overweight/obesity on a woman’s fertility and reproductive health. (Information extracted from Pasquali and Gambineri (2006).)

More recently, it has come to light that body fat, once thought to be a fairly redundant mass, may be involved in the production of another type of hormone, known as adipokines. So far, four key adipokines have been identified: adiponectin, visfatin, omentin and vaspin. Although there remains a lot to be learnt about the role of these hormones, it is thought that they may help to regulate women’s menstrual cycles (Bohler et al., 2010) and improve insulin sensitivity (Campos et al., 2008).

Finally, another theory known as the ‘metabolic fuel hypothesis’ proposes that limited supplies of body fat can lead to altered secretion of key fertility hormones such as gonadotropin-releasing hormone (GnRH) and luteinising hormones (LH). In turn, this can then lead to women having irregular or no menstrual cycle, alter her feelings towards sexual activities and ultimately reduce the ability to conceive (Figure 1.1). Examples of these conditions may include women with eating disorders such as anorexia nervosa or very active females, which can lead to exercise-induced amenorrhea (Mircea et al., 2007).

1.2.5 Overnutrition

Obesity is becoming an increasing health concern in both developed and newly industrialised countries. Overweight/obese women are more likely to have experienced fertility problems than women with a healthy body weight. A considerable proportion of women who are obese have PCOS, which reduces their fertility. Other conditions such as insulin resistance, excess androgen production and irregular ovulation can also make conception more difficult in heavier women (Wilkes and Murdoch, 2009).

Some research has also found that body shape and the distribution of body fat can be used to assess women’s likelihood of menstrual irregularities. Research carried out at the University of Bari, Italy, found that about 20% of women with obesity had irregular menstrual cycles. These women also had higher waist circumferences and more fat in the abdominal region (De Pergola et al., 2009).

For overweight/obese women seeking fertility treatment, the British Fertility Society (BFS) advise that women strive to attain a healthy body mass index (BMI) before undergoing these treatments. There are many different reasons for this advice. Firstly,
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Table 1.3  Some practical approaches to achieving and maintaining a healthy weight.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Base meals on starchy foods (such as potatoes, bread, rice and pasta), choosing wholegrain where possible</td>
<td>7. Aim to lose 5–10% body weight before undergoing fertility treatments, or the equivalent to a BMI &lt;35 kg/m², or 30 kg/m² for younger mothers (Balen et al., 2007)</td>
</tr>
<tr>
<td>2. Eat foods rich in dietary fibre (i.e. fresh fruits and vegetables and wholegrains)</td>
<td>Also incorporate exercise into your daily regime and seek support from relative health practitioners where possible</td>
</tr>
<tr>
<td>3. Eat at least five portions of fruit and vegetables per day in place of foods higher in fat or calories</td>
<td></td>
</tr>
<tr>
<td>4. Eat as little as possible of fried foods, and drinks and confectionary high in sugars and fats</td>
<td></td>
</tr>
<tr>
<td>5. Eat breakfast</td>
<td></td>
</tr>
<tr>
<td>6. Watch portion size of meals and how often they are eaten</td>
<td></td>
</tr>
</tbody>
</table>

ARTs are not as successful in heavier mothers, which can lead to unnecessary expenses and disappointment. Secondly, if obese/overweight women were to conceive, this may lead to a host of complications in pregnancy and during delivery (see Chapter 9 for further information). Specifically, the BFS advise that women defer their medical treatment until they obtain a BMI of 35 kg/m² or less, although treatment is preferable in women with a BMI of 30 kg/m² or less, particularly in the case of younger mothers (Balen et al., 2007). Dieticians, nurses and midwives can play a key role in helping women to achieve these weight loss guidelines and the BFS state that even moderate weight losses of 5–10% may help women to restore their fertility naturally. Most recently, the National Institute for Health and Clinical Excellence have published some useful guidelines to help women of childbearing age maintain a healthy weight (NICE, 2010). These guidelines alongside the BFS recommendations are summarised in Table 1.3.

1.2.6 Dietary components

Scientists from the Harvard School of Public Health have studied whether the consumption of specific dietary constituents has any effect on women’s ovulation. Dietary and reproductive assessments were carried out on over 16,000 nurses taking part in the American Nurses Health Study. Nutrition scientists found that carbohydrate-rich foods, especially those with a high glycaemic load, diets rich in animal protein, trans fats and iron, or low in vegetable protein and folic acid were most commonly linked to ovulation problems and subsequent infertility (also see Table 1.4). Authors suggested that swapping just 5% of total energy intake with vegetable rather than animal protein could reduce ovulatory infertility by 50%, possible because it helps to improve insulin sensitivity (Chavarro et al., 2008a). Some other findings from studies carried out by Dr Jorge Chavarro are shown in Table 1.4. Until recently, very few studies have focused on research in this area. It seems that dietary constituents could alter the ovulatory function by modulating either insulin sensitivity or the fat content of the diet. Although the findings from these studies are
Table 1.4 Dietary constituents and ovulatory infertility.

<table>
<thead>
<tr>
<th>Dietary constituent under investigation</th>
<th>Findings</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>Alcohol intakes were unrelated to ovulatory infertility</td>
<td>Chavarro et al. (2009b)</td>
</tr>
<tr>
<td>B vitamins</td>
<td>Folic acid (mainly supplied from multivitamins) was associated with a reduced risk of ovulatory infertility</td>
<td>Chavarro et al. (2008b)</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Intakes of soft caffeinated drinks were associated with ovulatory infertility (but may be unrelated to caffeine)</td>
<td>Chavarro et al. (2009b)</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>Risk of ovulatory infertility was higher in women eating carbohydrates with a high glycaemic load</td>
<td>Chavarro et al. (2009a)</td>
</tr>
<tr>
<td>Dairy produce</td>
<td>Risk of ovulatory infertility was higher in women eating low-fat compared with high-fat dairy foods</td>
<td>Chavarro et al. (2007b)</td>
</tr>
<tr>
<td>Fat</td>
<td>Risk of ovulatory infertility increased with intakes of trans fats.</td>
<td>Chavarro et al. (2007a)</td>
</tr>
<tr>
<td>Iron</td>
<td>Women who consumed iron supplements had a reduced risk of ovulatory infertility</td>
<td>Chavarro et al. (2006)</td>
</tr>
<tr>
<td>Protein</td>
<td>Risk of ovulatory infertility was higher in women consuming animal protein compared with vegetable protein</td>
<td>Chavarro et al. (2008a)</td>
</tr>
</tbody>
</table>

Folic acid or iron supplements were associated with a reduced risk of ovulatory infertility. Drinking soft beverages and consuming high-fat dairy foods, foods rich in trans fats or those with a high glycaemic load were linked to ovulatory infertility. Swapping animal for vegetable protein may also help to improve ovulatory function.

*No or irregular ovulation leading to infertility.

Very interesting, more research is needed to confirm how these dietary constituents may exert their actions.

Research Highlight Can dietary fibre influence women’s fertility hormone levels?

Dietary fibre, the indigestible part of carbohydrates, may be beneficial to health when consumed at the right levels. Now, a new study suggests that high-fibre diets could influence levels of fertility hormones in childbearing age women.

The American BioCycle Study recruited 250 women aged 18–44 years and monitored their dietary habits and levels of fertility hormones across two menstrual cycles. Scientists found that women eating diets containing more fibre had lower levels of certain hormones. Levels of oestradiol, an active oestrogen hormone, progesterone, LH and FSH were all lower when more fibre was consumed. Ovulation was not likely to occur and menstrual cycles defined as ‘anovulatory’ if peak progesterone levels were 5 ng/mL or less. Women eating higher levels of dietary fibre, especially soluble fibre were also significantly more likely to experience anovulation (Gaskins et al., 2009).
Whilst there are very interesting results, they are the findings from just one study. Future trials should study women for more than two menstrual cycles and control very carefully for other dietary components, as it can be difficult to separate out the effects of other nutrients. It would also be interesting to study the different fibre forms in further detail, i.e. soluble versus insoluble. An intervention study in the form of a randomised controlled trial would be particularly useful in this sense.

One of the issues that do emerge from these findings is that dietary fibre guidelines for women may need to be tailored when there is more evidence. Whilst dietary fibre may be associated with a spectrum of health benefits related to women’s health, i.e. improved cardiovascular well-being and reduced risk or certain cancers, it is possible that upper levels of intake may be warranted. Consuming a diet adequate in fibre should by no means be discouraged; most adults fall short of recommended guidelines. However, women eating diets particularly high in fibre (defined as more than 22 g/day in the present study) who are experiencing difficulties conceiving may consider revising these slightly.

### 1.2.7 Oxidative stress and antioxidants

Reactive oxygen species (ROS) are highly reactive molecules generated both by metabolic pathways and environmental stresses. An accumulation of ROS can cause cell damage, especially to ova (egg cells). Subsequently, ROS can affect the development of ova and likelihood of fertilisation. Scientists also suggest that increased levels of ROS may contribute to oxidative stress, which can accelerate the age-related decline in fertility levels (Agarwal et al., 2005). There is also some evidence to indicate that the production of ROS may increase the risk of medical complications, such as pre-eclampsia (Ruder et al., 2009).

Several studies have investigated whether antioxidant supplements can reduce the production of ROS and reduce levels of oxidative stress in women of reproductive age. However, these are generally limited in number and use small sample sizes. An example of such research was carried out by Westphal et al. (2006). Ninety-three women aged 24–42 years who were having problems conceiving were asked to take either fertility supplements containing catechins (a source of antioxidants) or placebo over the course of 3 months. After the intervention ended, 26% of women taking the supplement conceived compared with just 10% in the control group. Although levels of oxidative stress were not measured directly in this study, the results do indicate that supplements may go some ways towards improving the chances of conception. Another study carried out by Crha et al. (2003) measured levels of ascorbic acid in the follicular fluid of 76 women with fertility problems after half were given 500 mg supplements. Ascorbic acid levels were found to be significantly higher in the follicles of women that had taken vitamin C supplements when compared to the control group. Equally, pregnancy rates were also higher (58% versus 32%) in those taking the vitamin C supplement compared with the control group.

To date, these were the two most relevant studies that could be found within the literature. There seems to be more research investigating how antioxidants can affect male fertility, possible because this is easier to study. The role of antioxidants
in female fertility is largely understudied, and this area of research would benefit from further clinical trials.

1.2.8 Alcohol

Increasingly, more young women are drinking higher proportions of alcohol, a trend that is a strong predictor of later consumption (Clemens et al., 2009). For women, the absence of menstruation, failure to ovulate and disruption of the LH spike are just some of the medical problems linked to heavy drinking. When consumed in excess, alcohol can act on the hypothalamic–pituitary–adrenal (HPA) axis, altering the secretion of hormones. Studies have shown that alcohol increases plasma oestradiol and prolactin levels, which may subsequently increase the risk of spontaneous abortion (Teoh and colleagues, 1990). Grodstein et al. (1994) interviewed 1050 women from infertility clinics and found that endometriosis was 50% higher in women drinking any level or form of alcohol. Overall, a wealth of research has looked into how alcohol can influence women’s fertility, but in this section, we will just focus on the key publications.

In one study, Swedish scientists measured patterns of alcohol consumption, rates and causes of hospital admission in a large sample of over 7000 women over a period of 18 years. Women with higher alcohol intakes were more likely to seek advice from fertility experts, suggesting link between the two (Eggert et al., 2004).

In another key study, data extracted from the Danish National Birth Cohort gave insight into beverage habits and time to conception. The retrospective study of 30,000 pregnant mothers found that wine drinkers had a shorter time to pregnancy when compared with other alcoholic beverages such as beer or spirits. At the other end of the spectrum, drinking no or high levels (>14 alcoholic beverage per week) were linked to longer times to pregnancy (Juhl et al., 2001). These are important research findings, but there is a definite need for well-designed studies controlling for other lifestyle factors that can also affect time to pregnancy, i.e. smoking.

Finally, and as will be discussed in later chapters, it is relatively well known that if alcohol intakes are high and pregnancy occurs, there is a chance that the offspring may develop a foetal alcohol-related disorder (Monsen, 2009). There is even some evidence that alcohol intakes ‘before’ conception occurs may alter the HPA axis and alter foetal programming when conception occurs (Zhang et al., 2005). More remains to be known about this field of research, but it is possible that this may affect the behaviour, cognitive and immune function of the offspring in the long term. Public health campaigns need to be devised to deliver the message that high levels of alcohol consumption can decrease fertility and if conception does occur, it can impinge upon the health status of the developing child.

1.2.9 Caffeine

Caffeine consumption and its relationship with fertility have been investigated in some detail, with mixed evidence. Animal studies show that the administration of caffeine before fertilisation reduces the eggs ability to implant in the uterus (Pollard et al., 1999). Evidence from human studies is not as consistent, reporting mixed
findings. In these epidemiology studies, it is often difficult to separate out the effects of caffeine and smoking and their individual effects on fertility.

To date, the European Study Group on Infertility and Subfecundity is one of the largest investigations studying the effects of caffeine intake on female fertility. In this study, the consumption of caffeinated beverages was monitored in a randomly selected sample of 3187 women recruited from Denmark, Germany, Italy, Poland and Spain (aged 25–44 years). Findings were consistent in all countries: women consuming higher levels of caffeine took longer to conceive (those with intakes over 500 mg/day had an 11% longer time to pregnancy) (Bolumar et al., 1997). More recently, the Oxford Conception Study has started to collect data from 1453 women planning to have a baby. Urinary hormones levels and health and lifestyle information, including measures of caffeine intake have been taken. This research will provide future information about factors influencing time to conception (and fertility) (Pyper et al., 2006).

### 1.2.10 Physical activity

The female reproductive system is highly sensitive to changes in energy balance. At the extreme end of the energy spectrum, when energy expenditure is high and not matched with an equal energy intake, reproductive disorders may arise. Reduced levels of body fat and altered levels of endocrine hormones (also see Table 1.5), often linked to highly active lifestyles, are common causes of reduced pregnancy rates. In turn and as touched on previously, these physiological changes may lead to irregular menstruation, anovulation and infertility. Scientists generally say that reproductive function should return to normal when energy balance is restored, but more research is needed to confirm this (Redman, 2006).

A number of studies have explored the link between levels of female physical activity and their fertility. One Norwegian study, the North-Trondelag Health Study, recruited 3887 women (45 years or younger) and studied patterns of physical activity and fertility over a ten-year period. After accounting for other factors that could affect fertility, results showed that women active on most days of the week were 3.2 times more likely to experience fertility problems than inactive women. Authors concluded

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Action</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>GnRH</td>
<td>Stimulates the release of LH and FSH</td>
<td>↓ GnRH can suppress the LH surge which normally takes place mid-cycle when conception is most likely to take place</td>
</tr>
<tr>
<td>Leptin</td>
<td>Regulates energy balance and reproductive function</td>
<td>↓ leptin occurs when there is a reduction in body fat</td>
</tr>
<tr>
<td>Oestrogens</td>
<td>Maintain reproductive cyclicity</td>
<td>↓ oestradiol when body fat levels decline. May result in anovulation (failure to ovulate)</td>
</tr>
<tr>
<td>Progesterone</td>
<td>Stimulates the formation of the endometrium lining</td>
<td>↓ progesterone means that implantation of a fertilised ovum is unlikely or may increase the risk of miscarriage</td>
</tr>
</tbody>
</table>
that women taking part in intensive levels of physical activity had the highest risk of infertility. This is an interesting study, but it is important not to discourage women from taking part in regular physical activity.

Overall, evidence seems to suggest that women are mostly at risk of fertility problems when energy expenditure is at the extreme end of the energy spectrum, i.e. women are taking part in high levels of physical activity but not matching this with adequate energy intakes. It is very important that the right health messages are communicated, i.e. when undertaken in moderation, physical activity may be beneficial to reproductive health but women with very active lifestyles should be advised to monitor their energy expenditure and energy intakes if they are planning a pregnancy.

1.2.11 Application in practice

Overall, studies show that dietary factors may influence time to conception and subsequently female fertility. There appears to be relatively consistent evidence from studies investigating the link between alcohol intakes and fertility levels that high alcohol intakes can reduce the likelihood of a successful conception. Scientific studies researching the effects of antioxidants, micronutrients and links with female fertility are generally limited and, there is a clear need for the application of rigorous randomised control trials within this area.

With the development of future research, it is hoped that health messages identifying the importance of dietary, lifestyle factors could go some way towards improving the fertility of women in their childbearing years. This would help to reduce the costs of expensive fertility treatments as well as improving the health and wellbeing of couples. In particular, the importance of being a healthy body weight before conception has many benefits – improved natural fertility, increased success when fertility treatments are sought and improved pregnancy outcomes. However, these benefits do not appear to be well communicated within public sectors. Further work in this area in the form of both research and public health strategies would be a good way forward. Ultimately, achieving a healthy BMI before pregnancy would help to cut the costs of fertility treatments and give women a healthy start to their pregnancies. A summary of key points from the first part of this chapter (nutrition and female fertility) is included in Table 1.6.

Table 1.6 Nutrition, lifestyle and female fertility – key points.

- Women should be advised to meet NICE (2010) dietary and lifestyle guidelines (Table 1.3).
- This includes achieving a healthy body weight before becoming pregnant, i.e. when planning a pregnancy or undergoing fertility treatments. Ideally, a woman’s BMI should be $<35\text{ kg/m}^2$, or $<30\text{ kg/m}^2$ in younger women (Bates et al., 2007).
- Women should get the nutrients they need from a healthy balanced diet, but in certain circumstances, women may benefit from taking an additional antioxidant supplement, i.e. female smokers.
- Older mothers having problems conceiving should be referred to a dietician/nutritionist to ensure that they have the best chances of reproductive success.
- Women should be encouraged to reduce their alcohol intake when planning a pregnancy.
- Women need to be aware that very active lifestyles may encumber fertility.
1.3 Nutrition and male fertility

1.3.1 Trends in male fertility

Data relating to basic sperm parameters can be obtained from as far back as the 1920s, although methods of determining male fertility have changed considerably since then. A controversial paper published in 1992 identified that there had been an overall decline in semen quality over the past 50 years (Swan and Elkin, 1999). Authors proposed that increased rates of testicular cancer, hypospadias (a birth defect of the urethra in males), cryptorchidism (when one or both testes fail to descend) and increased exposure to oestrogens may all be leading to a reduction in male fertility (Carlsen et al., 1992). This paper was criticised because the methods used to assess fertility were not highly regarded and the same sample of men were not followed through over time, making firm conclusions difficult.

Since then some better designed studies have been carried out. One of these was conducted in New Zealand and it analysed sperm samples of men who were regular sperm donors. Sperm parameters from these samples were analysed over a period of 20 years. Scientists found that the concentration of sperm decreased by an average of 2.5% annually and the volume of semen declined from 3.7 mL to 3.3 mL, but motility remained unchanged (Shine et al., 2008). Even though this was a fairly well-designed study using a large sample of the same men over time and a range of sperm parameters, this still needs to be supported with more research using similar methodological approaches.

1.3.2 Semen – what is normal?

In 1992, the World Health Organisation (WHO) established a set of reference values for a range of semen variables (Table 1.7). Although new papers have been published, identifying ideal reference ranges for certain populations and age ranges, these values still remain to act as a useful guide and are often cited by doctors and researchers as a reference point. The same WHO report also identified and defined a set of nomenclature for different semen variables, which are shown in Table 1.8. More

Table 1.7 Normal values of semen samples.

<table>
<thead>
<tr>
<th>Test</th>
<th>‘Normal’ values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>2.0 mL or more</td>
</tr>
<tr>
<td>pH</td>
<td>7.2–8.0</td>
</tr>
<tr>
<td>Sperm concentration</td>
<td>(20 \times 10^6) spermatozoa per mL or more</td>
</tr>
<tr>
<td>Total sperm count</td>
<td>(40 \times 10^6) spermatozoa per ejaculate or more</td>
</tr>
<tr>
<td>Motility</td>
<td>50% or more with forward progression or 25% or more with rapid progression! (within 60 minutes of ejaculation)</td>
</tr>
<tr>
<td>Morphology</td>
<td>30% or more with normal forms</td>
</tr>
<tr>
<td>Vitality</td>
<td>75% or more live spermatozoa</td>
</tr>
<tr>
<td>White blood cells</td>
<td>Fewer than (1 \times 10^6)/mL</td>
</tr>
</tbody>
</table>

*Source: Adapted from WHO (1992).*
Table 1.8  Classifying semen samples (WHO nomenclature).

<table>
<thead>
<tr>
<th>Terminology used</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normozoospermia</td>
<td>Normal, healthy ejaculate</td>
</tr>
<tr>
<td>Oligozoospermia</td>
<td>When the sperm concentration is less than $20 \times 10^6$ per mL</td>
</tr>
<tr>
<td>Asthenozoospermia</td>
<td>When less than 50% spermatozoa move forward, or less than 25% move rapidly!</td>
</tr>
<tr>
<td>Teratozoospermia</td>
<td>When less than 30% spermatozoa have a normal morphology</td>
</tr>
<tr>
<td>Oligoasthenoteratozoospermia</td>
<td>When all three variables as shown above are affected</td>
</tr>
<tr>
<td>Azoospermia</td>
<td>When there are no sperms in the ejaculate</td>
</tr>
<tr>
<td>Aspermia</td>
<td>When ejaculate is not produced</td>
</tr>
</tbody>
</table>

Source: Adapted from WHO (1992).

recently, new tests have been developed to assess whether sperms have been exposed to oxidative stress and to determine the stability of nuclear and mitochondrial DNA in sperm cells (Aitken, 2006).

### 1.3.3 Paternal age

The effects of age-related infertility are not just confined to females. For males, having children later in life may impact upon sperm quality, hormone levels, libido and erectile function. Although age-related changes in semen parameters vary between individuals, it has been suggested that a paternal age of $\geq 40$ years may contribute to reduced fertility, particular when the female is also older (Kühnert and Nieschlag, 2004).

A recent study analysing the sperm quality of over 400 males found that sperm motility decreased with age, but there were no changes in other parameters (Winkle et al., 2009). It has also been identified that semen ROS levels are often higher in men 40 years and older compared with younger men (Cocuzza et al., 2008). This may in turn increase the risk of DNA damage, which may reduce fertility but could also increase the risk of pregnancy complications and genetic abnormalities in the offspring born to older males (Sartorius and Nieschlag, 2010). Table 1.9 summarises how age may influence male fertility and reproductive health.

### 1.3.4 Overnutrition

Although more follow-through studies with larger sample sizes are needed, several studies have investigated the effects of male obesity on fertility. It has been reported that men with a BMI over 25 kg/m$^2$ are less likely to have healthy, mobile sperm cells in their ejaculate (Kort et al., 2006). Equally, medical conditions that are linked to obesity, such as diabetes development may influence men's fertility levels indirectly. Because diabetes can increase blood pressure, reduce the supply of blood to the penis and damage nerve endings, men with diabetes are at particularly high risk
1.3.4 Men's Age and Reproductive Health

Table 1.9 How can men's age affect their fertility and reproductive health?

| ↓ libido | ↓ erectile function | ↓ semen volume | ↓ percentage of healthy sperm | ↓ sperm motility | ↑ DNA damage and ↓ sperm quality | ↑ risk of miscarriage after women conceive | ↑ risk of genetic medical conditions in the offspring |

Men who have waited longer to have children should be advised how simple dietary and lifestyle changes may improve the chances of having a healthy baby.

of erectile dysfunction (Tamler, 2009). Physiologically, there are many reasons as to why obesity may affect reproductive function in males but some of the main explanations are listed below:

- In overweight/obese males, the hormone testosterone may be converted to oestrogen in surplus adipose tissue, leading to reduced testicular function and hormone production.
- Obesity may increase levels of oxidative stress in the testicles. This can lead to reduced sperm production and increased sperm damage.
- An accumulation of fat (particularly in the inner thigh) may cause scrotal temperatures to rise in extreme cases of obesity.
- Levels of inhibin B (a peptide hormone involved in sperm production) may be lower in obese compared to healthy weight males.

Overall, it is certainly not clear, but it seems likely male overweight/obesity could have some affect on fertility. A recent meta-analysis paper by MacDonald et al. (2010) reviewed the finding from 31 studies researching the effects of male obesity on sperm parameters. From the 31 studies that were found, only the results of five were suitable for statistical analysis. Authors concluded that men with a higher BMI had significantly lower testosterone levels. Obesity was not, however, found to affect any semen parameters. Despite these conclusions, small sample sizes and short study timescales mean that continued research is needed in this area.

### 1.3.5 Metabolic syndrome

Interest in metabolic syndrome, a series of metabolic and cardiovascular risk factors that may precede the development of type 2 diabetes, stroke and heart disease (Ramos and Olden, 2008) has advanced over the last few years. Using the International Diabetes Federation (IDF) classification scale, prevalence of metabolic syndrome is thought to be around 33% amongst men and 35% in women, although this method is thought to slightly overestimate prevalence (Ford, 2005).

Although some research has looked at how the individual components of metabolic syndrome (Table 1.10) may affect male fertility, more work is needed. Canadian scientists Kasturi et al. (2008) have concluded that obesity/overweight, insulin resistance and dyslipidemia may increase the chances of infertility in men. The interactions
Table 1.10  Worldwide definition of metabolic syndrome.

Central obesity (waist circumference ≥94 cm for European men and ≥80 cm for women)*
Combined with additional two of the following:
• Raised triglyceride level: > 150 mg/dL (1.7 mmol/L)
• Reduced HDL cholesterol: < 40 mg/dL (0.9 mmol/L) on males and < 50 mg/dL (1.1 mmol/L) in females
• Raised blood pressure: systolic blood pressure ≥130 or diastolic ≥85 mmHg.
• Raised fasting plasma glucose: ≥100 mg/dL (5.6 mmol/L)

*Additional cutoffs should be used for other ethnic groups.

between components of metabolic syndrome and male fertility are shown in Figure 1.2. In the Middle East, where this prevalence of male diabetes is high, one study found that over half of the men with diabetes who were infertile were also obese. It was concluded that these combined medical problems along with high rates of smoking may be contributing to the high rates of infertility experienced in this particular population of men (Bener et al., 2009).

1.3.6 Oxidative stress

Over the last 10 years, it has become increasingly known that oxidative DNA damage may be a contributing factor to poor semen quality and infertility. Oxidative stress
occurs when there is an imbalance between the generation of ROS and antioxidant levels in the body. ROS may include hydroxyl ions, superoxide, hydrogen peroxide, peroxyl radical and hypochlorite ion, all of which are a natural by-product of ongoing metabolic and physiologic processes (Makker et al., 2009).

Sperm cells are particularly susceptible to ROS because their plasma membrane comprises polyunsaturated fatty acids (PUFA), which oxidise easily. They also lack cytoplasm, the protective layer that surrounds the nucleus, which would normally act as a barrier and help repair damage caused by ROS (Agarwal and Prabakaran, 2005). Although ROS are generated endogenously, additional lifestyle and environmental factors can increase the production of ROS (smoking, alcohol use and environmental pollution) or, equally, protect against the effects of the ROS (antioxidant nutrients). When this balance is not maintained, accumulation of ROS can lead to altered sperm function and DNA damage.

### 1.3.7 Smoking

Tobacco smoke contains thousands of compounds, including alkaloids, nitrosamines and inorganic substances, many of which act as ROS. Although the trend between smoking and male infertility is well identified, the exact mechanisms of action are not well confirmed. Studies suggest that smoking is associated with modest reductions in semen quality, including sperm concentration, motility and morphology, but large, well-designed studies are lacking. Chemicals and carcinogens found in cigarette smoke may pass directly through the blood–testis barrier, directly affecting sperm function (Vine et al., 1996). Studies have clearly shown that the number of DNA strand breaks is higher in the sperm cells of smokers when compared with nonsmokers (Belcheva et al., 2004). Scientists think that fathers who smoke in the run-up to pregnancy could be putting the health of their offspring at risk. Eggs fertilised by male smokers are generally not as viable and the risk of childhood cancers is thought to be higher in offspring born to parents who smoke (Sepaniak et al., 2006). It is clear that smoking can affect male fertility, but larger studies now need to confirm whether a relationship between DNA integrity and childhood health exists. It would also be interesting to study whether stopping smoking helps to improve parameters of sperm function.

### 1.3.8 Alcohol

Alcohol is known to influence male fertility through several different mechanisms of action. Before describing how alcohol can affect fertility, it is important to describe the function of seminiferous tubules. As the name indicates, these are long tubes where sperm cells and ultimately semen are produced. Alcohol can affect sperm production and quality by acting directly on both Leydig cells inside these tubules, which produce testosterone, and Sertoli cells that line these tubules and play an active role in sperm production. Alcohol can also act on the hypothalamus part of the brain and alter the secretion of hormones that play a key role in male reproduction, namely, LH and FSH (Emanuele and Emanuele, 1998).

Unfortunately, although the physiological mechanisms in which alcohol acts appear to be well established, there is a lack of human trials. A recently published paper
has, however, studied the effects of chronic alcoholism on male fertility. Sixty-six male alcoholics were recruited from treatment clinics and 30 non-smoking, non-alcoholic controls were selected. Venous and semen samples were collected from both groups. It was identified that alcoholic patients had elevated LH, FSH and estradiol levels, whilst testosterone and progesterone levels were reduced. Semen volume, sperm count, motility, and the number of healthy sperms were also lower in the sperm samples of alcoholics. In summary, findings from this study demonstrated that heavy drinking can have a detrimental effect on both the secretion of male reproductive hormones and semen quality (Muthusami and Chinnaswamy, 2005).

1.3.9 Polyunsaturated fatty acids

Lipids play an important role in the structure and function of sperm cells. Sperm cells have a high PUFA, which helps them to be fluid, mobile and fertilise the ovum. Unfortunately, this also makes them susceptible to attack by ROS, which may ultimately affect their viability (Wathes et al., 2007). In some studies, the fatty acid content of sperm samples from healthy and infertile males has been analysed. Interestingly, it has been found that a higher proportion of saturated fatty acids are more likely to be present when either sperm concentration or motility is reduced. Equally, higher proportions of PUFA in sperm samples are found to be associated with improved sperm concentration, motility and morphology (Aksoy et al., 2006; Tavilani et al., 2006).

Overall, these studies show that the type and ratio of fatty acids present in sperm cells may influence their function. More work is now needed to confirm why this may occur and whether there is an ‘ideal ratio’ of PUFA: SFA (saturated fatty acids) to improve sperm function.

1.3.10 Antioxidants

Seminal plasma contains some natural antioxidant mechanisms that may protect against ROS and damage to spermatozoa to some extent. However, when levels of ROS exceed scavenging activities, sperm defects may occur. Antioxidant nutrients can play a key role in protecting spermatozoa from oxidative stress (Sheweita et al., 2005).

In a large observational study, the Age and Genetic Effects in Sperm (AGES) study set out to establish whether antioxidant intakes (from food and supplement sources) helped to protect against the age-related decline in male fertility. Ninety-seven males aged 20–80 years were recruited and asked to complete food frequency questionnaires. Researchers found that higher antioxidant intakes (particularly vitamins C and E) were significantly associated with increased sperm numbers and motility. Higher intakes of β-carotene improved the concentration of sperm. Overall, it was concluded that a diet containing sufficient amounts of antioxidants may help to offset the age-related decline in sperm quality (Eskenazi et al., 2005). Although several small clinical trials have demonstrated that antioxidants may protect against oxidative damage, evidence that antioxidant supplements may improve measures of semen quality is limited. Well-designed, randomised controlled trials are needed in the future to develop these areas of research.
### 1.3.11 Selenium

Selenium is an essential nutrient needed for normal testicular development, spermatogenesis, sperm motility and function. Like the antioxidants mentioned previously, selenium can protect against oxidative stress and prevent damage to sperm cells. In addition, the selenium-containing enzyme glutathione peroxidase also has antioxidant properties that help to protect against oxidative damage and improve the viability of sperm cells.

One of the largest randomised controlled trials undertaken to date tested whether supplementation with 200 μg/day selenium or a placebo improved sperm function in 468 infertile men. Supplements were taken daily over a 6-month study period followed by a 30-week treatment-free phase. Blood sample analysis showed that males taking selenium supplements had higher levels of testosterone and inhibin B. Semen parameters (concentration, motility and morphology) also were significantly improved in the group supplementing with selenium (Safarinejad and Safarinejad, 2009).

Overall, given the expense of medical treatment to improve parameters of seminal function, selenium supplementation may be a simple, inexpensive and safe alternative that could be used prior to reproductive technology, or alongside this. Similar well-designed studies are now needed to reinforce findings from this current research.

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#### Research Highlight

**Higher levels of ascorbic acid and zinc in semen samples linked to improved sperm quality**

Recent research has measured the levels of antioxidant nutrients ascorbic acid and zinc present in the semen samples of both fertile and infertile men. Although larger studies are needed to reconfirm the findings from this research, scientists found that men without fertility problems had significantly higher ascorbic acid levels in their sperm samples. In turn, higher levels of ascorbic acid were positively associated with the number of sperm cells present in samples and normal form and structure. Fertile men also had higher levels of zinc in their sperm samples, with smokers having some of the lowest zinc concentrations. The zinc content of sperm samples also correlated with sperm count and normal morphology. Scientists concluded that diets lacking in vitamin C and zinc may be risk factors contributing to reduced sperm quality and male infertility (Colagar and Marzony, 2009; Colagar et al., 2009).

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### 1.3.12 Lycopene

Lycopene (a carotenoid) is a powerful natural antioxidant, mainly obtained from tomatoes and tomato products in the human diet. There is some evidence to suggest that lycopene is important for the body’s natural defences and protect against oxidative stress. Studies investigating the role of lycopene supplementation on parameters of sperm function are generally limited, or poorly designed.

In one most recent study, six males were provided with 22.8 mg lycopene per day over a 2-week study period. Blood and seminal lycopene levels were measured at the
start and end of the study and analysed using high-performance liquid chromatography. Interestingly, the lycopene in this study was provided from tomato soup and investigators closely monitored the compliance of obliging participants. Scientists found that both blood and seminal levels of lycopene increased after the 2-week study period, but levels of oxidative stress remained unchanged (Goyer et al., 2007). Although this study gives us some insight into the bioavailability of lycopene and concentration in seminal plasma, considerably more work is needed. Further work is needed to confirm whether improvements in sperm motility and concentration are a direct result of the lycopene or due to the free radical scavenging ability of lycopene.

### 1.3.13 Isoflavones

Isoflavones are plant-derived polyphenolic compounds that act in a similar manner to oestrogen hormones (they have oestrogenic activity). Animal studies have shown that high levels of isoflavone consumption may be linked to decreased fertility, but few human studies have established whether there is a link between the two.

In one of the largest studies to date, the isoflavone intake of 99 males from couples having problems conceiving were asked to record their isoflavone intake of foods eaten in the previous three months. After accounting for factors that could influence the results, it was found that higher intakes of soy foods (Table 1.11) were associated with reduced sperm concentrations (but not related to motility, morphology or ejaculation volume) (Chavarro et al., 2008c). Although it needs to be confirmed exactly how isoflavones may exert their actions, there does appear to be a relatively strong link between the consumption of soy foods and sperm concentrations.

### 1.3.14 Phthalates

Phthalates are a group of man-made chemicals that are added to plastics to improve their durability, transparency and flexibility. Such plastics may be used in both household and consumer products, which mainly take the form of food packaging. Animal studies in the past using male rats have shown that exposure to these chemicals can affect the function of the male sex organs directly, reducing fertility.

### Table 1.11 Examples of soy foods.

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal/energy bars containing soy or soy protein</td>
</tr>
<tr>
<td>Cooked green vegetable soybeans</td>
</tr>
<tr>
<td>Lecithin, an emulsifier extracted from soybean oil</td>
</tr>
<tr>
<td>Meat alternatives – hydrolysed vegetable protein (made from soybeans)</td>
</tr>
<tr>
<td>Miso soup</td>
</tr>
<tr>
<td>Natto, used as a topping on rice or in miso soup, made from fermented cooked soybeans</td>
</tr>
<tr>
<td>Roasted soy nuts and soynut butter</td>
</tr>
<tr>
<td>Soy cheese, yoghurt and ice cream</td>
</tr>
<tr>
<td>Soy milk and shakes</td>
</tr>
<tr>
<td>Soy fibre, from the hulls and pulp of soybeans</td>
</tr>
<tr>
<td>Soy flour, made from roasted soybeans ground into a fine flour</td>
</tr>
<tr>
<td>Soy sauce</td>
</tr>
<tr>
<td>Soy sprouts</td>
</tr>
<tr>
<td>Tempeh (a high-protein Indonesian food made from cooked and slightly fermented soybeans)</td>
</tr>
<tr>
<td>Tofu and tofu products</td>
</tr>
</tbody>
</table>
Table 1.12 Nutrition, lifestyle and male fertility – key points.

- Men should be guided to achieve a healthy body weight when planning a pregnancy (ideally a BMI less than 25 kg/m²)
- Men should also be encouraged to consume a healthy, balanced diet that includes at least five daily portions of fruit and vegetables
- Males smokers should ensure that their diet contains antioxidant-rich foods or consider taking a selenium supplement (200 μg/day has been found to have clinical benefits; Safarinejad and Safarinejad, 2009)
- Men should be encouraged to reduce their alcohol intake when planning a pregnancy
- Men should ensure that they are including polyunsaturated fatty acids within their diets (i.e. eating at least two portions of oily fish per week)
- Men with subfertility or infertility (particularly Asian males) may consider monitoring their intakes of isoflavones

One human study comprising 379 men recruited from American infertility clinics found that urinary excretion of phthalate metabolites were directly related to levels of DNA sperm damage, even after controlling for levels of oxidative stress (Hauser et al., 2007). More recently, however, new evidence shows that exposure may also affect the reproductive development of male offspring, leading to medical conditions such as cryptorchidism (when the testes fail to descend into the scrotum), hypospadias, a medical complication where the urethra is located on the wrong side of the penis and low-sperm counts (Martino-Andrade and Chahoud, 2010).

1.3.15 Application in practice

Overall, scientific evidence suggests that dietary factors (particularly antioxidants) can play an important role in improving sperm quality and parameters of sperm function. In addition, although better designed studies are needed, rising rates of obesity and diabetes may also be contributing to fertility problems in men, as well as the fact that many couples are waiting longer to have children, particularly in Western regions. It is well known that alcohol can cause oxidative stress, but better designed clinical trials are needed to assess how high intakes directly affect sperm parameters. For other dietary and lifestyle components, such as the role of isoflavones and effect of metabolic syndrome, evidence is only just starting to emerge. Although it can be recognised that there are many gaps within the field of nutrition and male fertility, some simple recommendations have been compiled based on the best evidence that is available to date. These are summarised in Table 1.12.

1.4 Conclusion

Infertility and subfertility seem to be becoming an increasingly frequent occurrence, particularly in Western regions. Although this may be attributed to couples waiting longer before they have children, changing dietary and lifestyle habits may have a role to play. For couples who are having problems conceiving, ARTs can be expensive and are not always available to everyone. A thorough evaluation of literature presently available has shown that simple measures such as achieving a healthy body weight and making some simple dietary and lifestyle changes could help couples to achieve a healthy pregnancy. It is hoped that larger, well-designed clinical studies
will continue in this important area so that government policies and evidence-base practical guidelines can be imparted to public sectors in the future.

**Key Messages**

- In Western regions, there is a tendency for couples to wait longer before planning a pregnancy; simple dietary and lifestyle changes may help to improve reproductive health and reduce time to pregnancy.
- For couples seeking the use of ARTs, the success of these fertility treatments may be reduced (particularly for women) if they are overweight or obese.
- Both the BFS and NICE advises that women achieve a healthy body weight before becoming pregnant or when undergoing fertility treatments. Ideally, a woman's BMI should be <35 kg/m² or <30 kg/m² in younger women (Bates et al., 2007).
- Both women and men should avoid consuming large amounts of alcohol when planning a pregnancy.
- For male smokers, although quitting is the best course of action, consuming a diet rich in antioxidants (i.e. vitamin C, selenium and zinc) or taking an antioxidant-containing supplement may be of benefit.
- Nurses and healthcare practitioners can play a key role in supporting couples having trouble conceiving and offering appropriate guidance.
- It is important that healthcare messages are conveyed to women and men of child-bearing age about the benefits a healthy lifestyle can have on fertility and the health of the next generation.
- Overall, a multi-faceted approach should be taken to improve female and male fertility, which involves evaluating diet quality, harmful environmental and occupational risk factors.

**Recommended reading**


**References**


Nutrition in the Childbearing Years


Nutrition in the Childbearing Years