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Optimizing natural fertility: a committee opinion

Practice Committee of the American Society for Reproductive Medicine and the Practice Committee of the Society for Reproductive Endocrinology and Infertility

The American Society for Reproductive Medicine, Birmingham, Alabama

This committee opinion provides practitioners with suggestions for optimizing the likelihood of achieving pregnancy in couples or individuals attempting conception who have no evidence of infertility. This document replaces the document of the same name previously published in 2013 (Fertil Steril 2013;100:631–7). (Fertil Steril® 2022;117:53–63. ©2021 by American Society for Reproductive Medicine.)

El resumen está disponible en Español al final del artículo.

Key Words: Pregnancy, environment, lifestyle, fertile window, fecundity

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Clinicians may be asked to provide advice about sexual and lifestyle practices relating to procreation. This document will provide practitioners with recommendations, based on a consensus of expert opinion, for counseling women and men about how they might optimize the likelihood of achieving natural, non-medically-assisted pregnancy when there is no history of infertility or reason to question their potential fertility. Any patient encounter with nonpregnant women or men with reproductive potential is an opportunity to counsel them about wellness and healthy habits to optimize reproductive outcomes (1, 2).

FERTILITY AND AGING

Fertility is defined as the capacity to produce a child. The likelihood of conception is generally highest in the first few months of unprotected intercourse and declines gradually thereafter (3). Approximately 80% of couples will conceive in the first 6 months of attempting pregnancy (3). Monthly fecundability (the probability of pregnancy per month) is greatest in the first 3 months (3). Relative fertility is decreased by about half at age 40 compared with women in their late 20s and early 30s, the time of peak fertility (4, 5).

Fertility varies among populations and declines with age in both women and men, but the effects of age are much more pronounced in women (6, 7) (Fig. 1). There is an age-related decline in the chances of pregnancy and live birth, corresponding to an increased risk of aneuploidy and miscarriage with maternal aging (8). In a landmark study in Hutterites, whose societal pressure is to reproduce until menopause, pregnancies occurred rarely during the 40s, with the average age of the mother at the last pregnancy just before turning 41 years old. Markers of ovarian reserve also decline with increasing age but are poor predictors of fecundity in noninfertile women (9, 10). Although semen parameters in men also decline detectably after 35 years of age, male fertility does not appear to be appreciably affected before the age of approximately 50 (11).

Infertility is a disease, defined as the failure to achieve a successful pregnancy after 12 months or more of regular unprotected vaginal intercourse (12). Earlier evaluation and treatment may be justified on the basis of the medical history and physical findings and is warranted after 6 months without conception for women aged 35 years and older due to the age-related decline in fertility (8, 12).

THE FERTILE WINDOW

For counseling purposes, the "fertile window" is best defined as the 6-day interval ending on the day of ovulation (13, 14). At least in theory, the viability of both oocytes and sperm should be maximal during that time. In a study of 221 presumed fertile women, peak fecundability was observed when intercourse occurred within 2 days before ovulation (14) (Fig. 2). In another family planning study, the investigators combined data obtained from two cohorts, one using basal body temperature monitoring and the other using analysis of urinary estrogen and progesterone metabolites, to determine the likely time of ovulation. The likelihood of pregnancy was greatest when intercourse occurred the day before ovulation and started to decline when intercourse occurred on the day of ovulation (15).

Among women who described their menstrual cycles as "generally regular," the likelihood of conception

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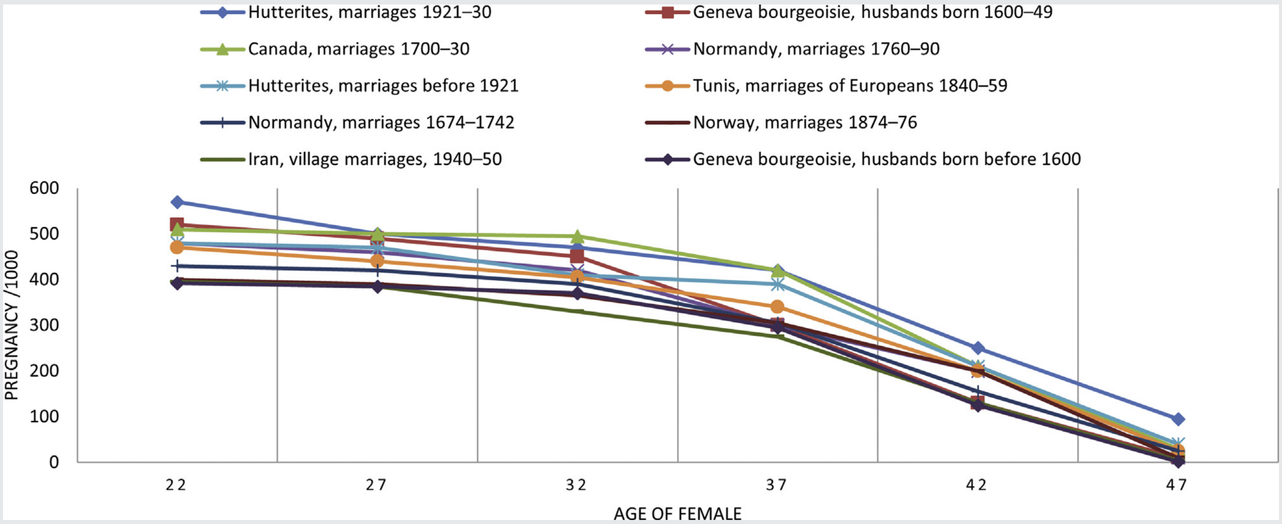
FIGURE 1



Pregnancy rate (per 1,000 women) in various populations at different times in history. Modified from Larsen et al. (7).

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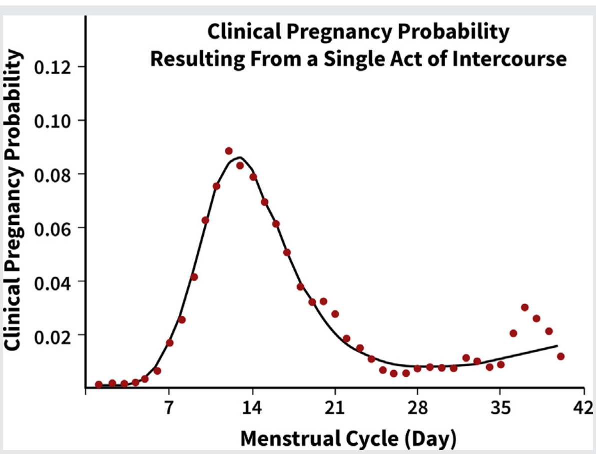
resulting from a single act of intercourse increases during the putative fertile window (16). The probability of clinical pregnancy increases from 3.2% on cycle day 8 to 9.4% on cycle day 12 and decreases to less than 2% on cycle day 21. Although it is thought that age does not affect the length or timing of the fertile window in relationship to ovulation, the likelihood of success decreases with increasing age (Fig. 3) (17).

FREQUENCY OF INTERCOURSE

Information has emerged over the past decade that may help to define an optimal frequency of intercourse. Whereas abstinence intervals greater than 5 days may adversely affect sperm counts, abstinence intervals as short as 2 days are associated with normal sperm densities (18). A widely held misconception is that frequent ejaculations decrease male fertility. A retrospective study that analyzed almost 10,000 semen specimens observed that in men with normal semen quality, sperm concentrations and motility remained normal, even with daily ejaculation (19). Surprisingly, in men with oligozoospermia, sperm concentration and motility may be highest with daily ejaculation (19). Abstinence intervals generally also do not appear to affect sperm morphology, as judged by ‘‘strict’’ criteria (20). However, after longer abstinence intervals of 10 days or more, semen parameters begin to deteriorate. Although studies of semen parameters provide useful quantitative data, these data may not accurately predict the functional integrity or capacity of sperm.

FIGURE 2



Probability of pregnancy resulting from a single act of intercourse. Modified from Dunson et al. (15).

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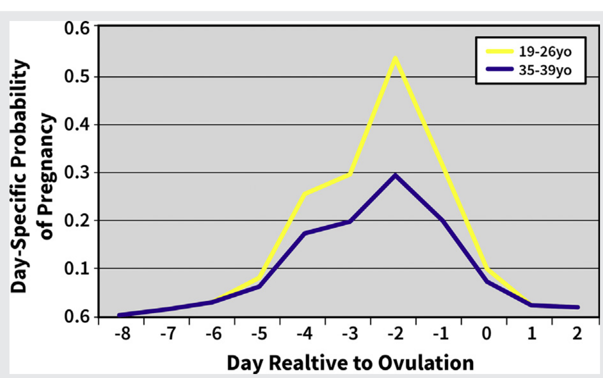
FIGURE 3



Probability of pregnancy resulting from recurrent intercourse by woman's age and cycle day. Data from Stanford and Dunson (17).

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Although evidence suggests that daily intercourse during the fertile window may confer a slight advantage, specific recommendations regarding the frequency of intercourse may induce unnecessary stress in the couple. In one study, cycle fecundity was similar with intercourse that occurred daily, every other day, and even every 3 days in the fertile window, but was lowest when intercourse occurred only once in the fertile window (14). Couples should be informed that reproductive efficiency increases with the frequency of intercourse and is highest when intercourse occurs every 1 to 2 days during the fertile window, but be advised that the optimal frequency of intercourse is best defined by their own preference within that context. Intercourse more frequently than every 1 to 2 days is not associated with lower fecundity, and couples should not be advised to limit the frequency of intercourse when trying to achieve pregnancy.

FERTILITY-AWARENESS METHODS

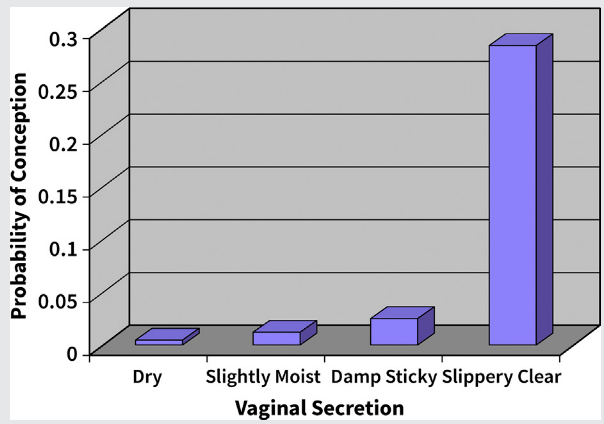
The timing of the fertile window within a given cycle can vary considerably, even in women who have regular cycles. Use of fertility-tracking methods to determine the fertile window and appropriately time intercourse is associated with an increased probability of conceiving in an ovulatory cycle (21). Fertility-tracking methods include the calendar method (with or without the assistance of a smart phone app), cervical mucus monitoring, ovulation detection devices, and basal body temperature tracking.

The calendar method is based on the length of the menstrual cycle. For all women, the length of the luteal phase is presumed to be approximately 14 days. Thus, the day of ovulation is set at cycle day 14 for a woman with a 28-day cycle, day 16 for a woman with a 30-day cycle, etc. The fertile window is set as the presumed day of ovulation and the 5 days prior (cycle days 9–14 in a woman with a 28-day cycle, cycle days 11–16 in a woman with a 30-day cycle, and so forth). Smart phone calendar apps, which use the calendar method, are becoming a popular first-line or adjunct fertility-awareness method (22). However the ability of app-based technology to precisely predict an individual's fertile window or ovulation day may not add to the clinical utility of traditional practices (23).

A study of 949 volunteers comparing urinary luteinizing hormone (LH) testing with multiple different downloadable calendar apps revealed a maximum accuracy of 21% in predicting the day of ovulation (24). The major pitfall of these predictors is that they are based on the assumption that the timing and duration of a woman's fertile window are consistent and dependent on cycle length characteristics, despite knowledge that cycles are much more variable (25, 26). Patients should be empowered to use this technology to assist in understanding their own personal cycle characteristics and trends; however this should be accompanied by a candid review of the shortcomings of the calendar method, with and without apps, for ovulation tracking.

Ovulation detection devices monitor urinary LH excretion to determine the day of ovulation. Some of these also monitor urinary estrone glucuronide levels to delineate other days in the fertile window (days of "high" but not "peak" fertility). Although numerous studies have validated the accuracy of methods for detecting the midcycle urinary LH surge (1, 2, 27), ovulation may occur any time within the 2 days thereafter (28, 29), and false-positive test results occur in approximately 7% of cycles (29). The use of ovulation detection devices has been shown in a randomized controlled trial to decrease the time to pregnancy (30).

FIGURE 4



Estimates of the probability of conception according to vaginal secretion observations on the day of intercourse. Data from Scarpa et al. (31).

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The quality of the cervical mucus (as detected by vaginal secretions at the introitus) provides an inexpensive and private index of when ovulation may be expected. The estimated probability of conception, in relation to the characteristics of cervical/vaginal secretions, is shown in Figure 4. The probability is highest when the mucus is slippery and clear (31), but such mucus is not a prerequisite for pregnancy to occur. The volume of cervical mucus increases with plasma estrogen concentrations over the 5 to 6 days preceding ovulation and reaches its peak within 2 to 3 days before ovulation (32). A retrospective cohort study including 1,681 cycles observed that pregnancy rates were highest (approximately 38%) when intercourse occurred on the day of peak mucus (day 0) and were appreciably lower (approximately 15% to 20%) on the day before or the day after the peak (33).

A prospective study including 2,832 cycles observed that changes in cervical mucus characteristics correlated closely with basal body temperature and predicted the time of peak fertility more accurately than a menstrual calendar (34). Cervical mucus monitoring in retrospective cohort studies is associated with a higher probability of conceiving in a given cycle (21, 35). One large study found that changes in cervical mucus across the fertile interval predicted the day-specific probability of conception as well as or better than basal body temperature or urinary LH monitoring (36).

Although some women may find fertility-awareness methods empowering, others may find that they induce unnecessary stress. The stress associated with trying to conceive can reduce sexual esteem, satisfaction, and the frequency of intercourse. These parameters are further aggravated when the timing of intercourse is linked to ovulation prediction methods or follows a strict schedule (37, 38). If fertility-awareness methods are employed, their use should guide the timing of frequent intercourse and not replace the approach to frequent intercourse every 1 to 2 days during the fertile window.

COITAL PRACTICES

Postcoital routines may become ritualized for couples trying to conceive. Although many women think that remaining supine for an interval after intercourse facilitates sperm transport and prevents leakage of semen from the vagina, this belief has no scientific foundation.

Sperm deposited at the cervix at midcycle are found in the fallopian tubes within 15 minutes (39). Furthermore, sperm traverse the fallopian tubes and are expelled into the peritoneal cavity rather than collecting in the ampullary portion of the fallopian tube (39). Studies in which labeled particles were placed in the posterior vaginal fornix at varying times of the cycle observed their transport into the fallopian tubes within as little as 2 minutes during the follicular phase (40). It is interesting that the particles were observed only in the tube adjacent to the ovary containing the dominant follicle and not in the contralateral tube. The number of transported particles increased with the size of the dominant follicle and after administration of oxytocin to simulate the increase in oxytocin observed in women during intercourse and orgasm.

There is no evidence that coital position affects fecundability. Sperm can be found in the cervical canal seconds after ejaculation, regardless of coital position. Although female orgasm may promote sperm transport, there is no known relationship between orgasm and fertility (41, 42). There also is no convincing evidence for any relationship between specific coital practices and infant gender.

Some vaginal lubricants may decrease fertility on the basis of their observed effects on sperm survival in vitro. Whereas commercially available water-based lubricants inhibit sperm motility in vitro by 60% to 100% within 60 minutes of incubation, canola oil has no similar detrimental effect (43). Some over-the-counter lubricants, olive oil, and saliva diluted to concentrations even as low as 6.25% adversely affect sperm motility and velocity, but mineral oil has no such effect (44–46). Hydroxyethylcellulose-based lubricants also have no demonstrable adverse impact on semen parameters (46). Although some lubricants adversely affect sperm parameters in vitro, the use of lubricants in couples attempting conception was shown not to affect cycle fecundability compared with nonuse (47, 48).

DIET AND LIFESTYLE

Diet

Fertility rates are decreased in women who are either very thin or obese, but data regarding the effects of normal variations in diet on fertility in ovulatory women are few (49). Elevated blood mercury levels from heavy seafood consumption have been associated with infertility (50). Women attempting to conceive should be advised to take a folic acid supplement (at least 400 μg daily) to reduce the risk of neural tube defects (51).

Multiple cohort studies have assessed the association between dietary patterns, macronutrients, micronutrients, and fertility. The Nurses' Health Study II assessed the efficacy of an investigator-defined "fertility diet," which encouraged higher consumption of monounsaturated rather than trans fats, vegetable rather than animal protein sources, low-glycemic carbohydrates, high-fat dairy, multivitamins, and iron from plants and supplements. The study demonstrated that increasing adherence to the "fertility diet" was associated with a lower risk of infertility related to ovulatory dysfunction (relative risk [RR] 0.34; 95% confidence interval [CI], 0.23–0.48) (52).

There are other studies that have evaluated diet in relation to outcomes in women utilizing assisted reproductive technologies (ART). It is unclear if these data apply to women attempting to optimize natural fertility, but given the overall lack of robust data, they are discussed here. For example, and contrary to what was found in couples not utilizing ART, increasing adherence to the "fertility diet" in the Nurses' Health Study II was not associated with rates of pregnancy or live birth in women utilizing ART (53). Another cohort study assessing a slightly different "pro-fertility diet" (higher intakes of supplemental folic acid, vitamin B_{12}, vitamin D, low-pesticide produces, whole grains, dairy, soy foods, and seafood rather than meats) demonstrated an increased probability of live birth among women utilizing ART who had higher pretreatment adherence to the pro-fertility diet (54). Similarly, studies have found that greater adherence to the Mediterranean diet (high intakes of vegetables, fruits, low-fat dairy, olive oil, fish, and poultry) or the Dutch diet (high intakes of whole grains, monounsaturated or polyunsaturated oils, vegetables, fruits, meat or meat replacements, and fish) was associated with higher rates of positive pregnancy tests (55), ongoing clinical pregnancy (56, 57), and live birth (56) following in vitro fertilization.

Alternatively, other cohort studies found no associations between higher adherence to the Mediterranean diet and rates of positive pregnancy tests (53, 56, 58), clinical pregnancy (53, 58), or live births (59) following use of ART. Likewise, no associations have been found between higher adherence to a "health-conscious low-processed" diet (higher intakes of vegetables, fruits, whole grains, nuts and legumes, long-chain omega-3 fats, polyunsaturated fat, and alcohol and lower intakes of sugar-sweetened beverages, fruit juice, red and processed meat, trans fat, and sodium) (55); the alternative health eating index 2010 diet (high intakes of fruits, vegetables, whole grains, fish, and legumes and low intakes of mayonnaise, snacks, and meat products) (53); diets with high intakes of seafood and vegetables (60); or a "Western" diet (high intakes of oil, meat, and chicken) (60) with rates of biochemical pregnancy, clinical pregnancy, or live birth after use of ART. Randomized, controlled trials are needed.

Although the results of cohort studies have been somewhat inconsistent, some investigators have suggested that aside from overall dietary patterns, individual micronutrients and macronutrients, such as multivitamins (61, 62), folic acid (63–68), long-chain omega-3 fatty acids (69–71), full-fat dairy (72–75), whole grains (76), vegetables (77), fish (78), and soy isoflavones (79–83), may have beneficial effects on fertility. Other micronutrients and macronutrients, such as trans fatty acids (52, 75), meat (77, 84), carbohydrates, and glycemic load (85), have been reported to have a negative impact on fertility. Again, better studies and randomized, controlled trials are needed.

Overall, although a healthy lifestyle may help to improve fertility in women with ovulatory dysfunction, there is little evidence that dietary variations, such as vegetarian diets, low-fat diets, vitamin-enriched diets, antioxidants, or herbal remedies, improve fertility in women without ovulatory dysfunction or affect the sex of the infant. In general, robust evidence is lacking that dietary and lifestyle interventions improve natural fertility, although dietary and lifestyle modifications may be recommended to improve overall health.

Smoking

Smoking has substantial adverse effects on fertility. A large meta-analysis comparing 10,928 smoking women with 19,128 nonsmoking women found that smoking women were significantly more likely to be infertile (OR, 1.60; 95% CI, 1.34–1.91) (86). The observation that menopause occurs, on average, 1 to 4 years earlier in smoking than in nonsmoking women suggests that smoking may accelerate the rate of follicular depletion (87, 88), although histologic studies have not confirmed this relationship (89). Smoking also is associated with an increased risk of miscarriage, in both naturally conceived pregnancies and those resulting from ART (90, 91). Although decreases in sperm density and motility and abnormalities in sperm morphology have been observed in men who smoke, the available data do not demonstrate conclusively that smoking decreases male fertility (92–94). The effects of smoking on fertility in men and women and the mechanisms that may explain its adverse impact are discussed at length in a separate Practice Committee report (95).

Alcohol

The effect of alcohol on female fertility has not been clearly established. Whereas some studies have concluded that alcohol has a detrimental effect, others have suggested that alcohol may enhance fertility. A cohort study of 7,393 women in Stockholm observed that the risk of infertility was significantly increased (relative risk [RR], 1.59; 95% CI, 1.09–2.31) among women who consumed two alcoholic drinks per day and decreased (RR, 0.64; 95% CI, 0.46–0.90) in those who consumed less than one drink per day (96). Other studies have also shown a trend toward higher alcohol consumption and decreased conception (96–99).

In contrast, data obtained by self-report from 29,844 pregnant Danish women suggested that time to conception was shorter for women who drank wine than for women who consumed no alcohol (100). However, a study of 1,769 postpartum Italian women found no relationship between alcohol consumption and difficulty conceiving (97).

Higher levels of alcohol consumption by women (more than two drinks per day, with one drink containing 10 g of ethanol) probably are best avoided when attempting pregnancy, but there is limited evidence to indicate that more moderate alcohol consumption adversely affects fertility. Of course, alcohol consumption should cease altogether during pregnancy, because alcohol has well-documented detrimental effects on fetal development, and no ''safe'' level of alcohol consumption has been established (98).

Chronic alcohol dependence in males has been associated with lower sperm counts, sperm motility, sperm morphology scores, seminal fluid volume, and serum testosterone levels (19, 20, 37). In one survey study, partners of men with heavy alcohol consumption had a longer time to pregnancy than partners of mild drinkers and nondrinkers (99). Although significant alcohol consumption has been associated with detrimental hormonal and semen markers in males, a dose–response pattern has not been established, and there is a lack of evidence for any effect of moderate alcohol consumption on male fertility (13, 37). Alcohol abuse is also associated with an increased risk of sexual dysfunction in males and females, with increased risks of ejaculatory dysfunction, premature ejaculation, decreased sexual desire, dyspareunia, and vaginal dryness (101–103).

Caffeine

High levels of caffeine consumption (500 mg; >5 cups of coffee per day or its equivalent) have been associated with decreased fertility (OR, 1.45; 95% CI, 1.03–2.04) (97). During pregnancy, caffeine consumption over 200 to 300 mg per day (2–3 cups per day) may increase the risk of miscarriage (104–106) but does not affect the risk of congenital anomalies. Overall, moderate caffeine consumption (1– 2 cups of coffee per day or its equivalent) before or during pregnancy has no apparent adverse effects on fertility or pregnancy outcomes. Caffeine consumption has no effect on semen parameters in men (94).

Cannabis and Other Recreational Drugs

One study found that the prevalence of infertility was increased in ovulatory women who reported using cannabis (RR, 1.7; CI 95%, 1.0–3.0) (107). Men who smoke cannabis have been reported to have 29% lower sperm counts than men who have never smoked cannabis, and a dose-dependent effect of cannabis on sperm counts has been reported (108–110). Cannaboid agonists can inhibit sperm hyperactivated motility and acrosomal reactions necessary for sperm binding to the zona pellucida, suggesting the potential for cannabis use to decrease fertilization pathways (110–114). However, data from the National Survey of Family Growth and North American Preconception Cohort Study demonstrated no association between male or female cannabis use and time to pregnancy (115, 116). The American College of Obstetricians and Gynecologists recommends that women who are pregnant or may become pregnant should discontinue cannabis use because of the adverse effects of smoking and potential concerns for impaired fetal neurodevelopment (117). The use of other recreational drugs by men and women desiring pregnancy is also discouraged because of the risks of pregnancy and neonatal complications.

Environmental Exposures

A growing body of evidence suggests that exposure to synthetic and naturally occurring environmental chemicals in food, water, air, and consumer products may contribute to reduced fertility in men and women. Of particular concern are endocrine-disrupting chemicals, a class of exogenous compounds that alter the hormonal and homoeostatic systems of organisms, resulting in adverse health effects (118). In a scoping review of 12 articles on nonpersistent exposure to endocrine-disrupting chemicals and time to pregnancy, the evidence largely indicated little to no association between exposure of women or men to the most commonly studied chemicals, such as phthalates, bisphenol A, and triclosan, and time to pregnancy (119).

However, in a systematic review of 28 articles on persistent organic pollutants and fecundability of couples, there was a high level of evidence supporting adverse effects of female exposure to polychlorinated biphenyls on time to pregnancy and weak evidence supporting adverse effects of female exposure to polybrominated diphenyl ethers and select per- and polyfluoroalkyl substances on time to pregnancy (120). There was little or no support for associations between female exposure to organochlorine pesticides and time to pregnancy and too few studies of male exposure to any of the persistent organic pollutants and fecundability to draw conclusions. Overall, reproductive-aged men and women seeking conception should be encouraged, to the extent possible, to limit their exposure to endocrine-disrupting chemicals in food, air, water, and personal care products.

The potential adverse effect of air pollution on fertility is another area of growing concern (121). Higher exposure to ambient air pollution has been linked to lower fertility rates in Europe (122), the United States (123), and China (124). Previous studies have shown that couples who live closer to major roadways have a higher risk of infertility (125) and longer time to pregnancy (126) than couples who live farther away. Moreover, women with higher preconception and early pregnancy exposure to nitrogen dioxides and fine particulate matter, such as experienced when living close to a major roadway, have been shown to have decreased fecundability (127, 128) and higher risk of miscarriage (53, 129, 130) than women with lower exposure. Numerous studies have also linked increased air pollution exposure to impaired semen parameters (131), including higher sperm DNA fragmentation and aneuploidy, lower sperm morphology and motility, and altered reproductive hormone levels. Overall, it remains to be determined whether the effects of air pollution on sperm parameters translate into effects on the fertility of couples.

SUMMARY

- The chances of pregnancy and live birth for women significantly decrease after age 35, as the risks of aneuploidy and miscarriage increase.
- The "fertile window" spans the 6-day interval ending on the day of ovulation. Frequent intercourse (every 1–2 days) during the fertile window yields the highest pregnancy rates, but results achieved with less frequent intercourse (2–3 times per week) are nearly equivalent. Couples should not be advised to limit the frequency of intercourse when trying to achieve pregnancy.
- The use of fertility-awareness methods, such as ovulation detection kits and cervical mucus monitoring, has been shown to increase the probability of conceiving in a given menstrual cycle.
- There is insufficient evidence that a specific diet or intake of particular macronutrients can improve natural fertility. Daily folic acid supplementation in women decreases the risk of neural tube defects in their children.
- Specific coital positions and postcoital routines have no impact on fertility.
- Alcohol abuse, recreational drugs, smoking, and high caffeine intake may all negatively impact fertility.
- Higher exposure to certain endocrine-disrupting chemicals, such as polychlorinated biphenyls, and to air pollution may adversely impact fertility in women.

CONCLUSION

- Time to conception increases with age. For women over 35, consultation with a reproductive specialist should be considered after 6 months of unsuccessful efforts to conceive.
- Intercourse every 1 to 2 days during the fertile window can help maximize fecundability.
- For couples who are unable to have regular frequent intercourse, fertility-awareness methods may help time frequent intercourse to the fertile window and decrease time to pregnancy.
- Smoking and recreational drugs should be discouraged in men and women attempting pregnancy. Alcohol and caffeine use should be limited to minimal to moderate use while trying to conceive.
- A healthy lifestyle and diet should be encouraged in men and women attempting to achieve pregnancy for their effects on general health.
- Women wishing to become pregnant should take a daily folic acid supplement (400 μg).
- Reproductive-aged men and women should be encouraged, to the extent possible, to limit their exposure to endocrine-disrupting chemicals in food, air, water, and personal care products, and to air pollution.

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appropriate, taking into account the needs of the individual patient, the available resources, and institutional or clinical practice limitations. The Practice Committees and the Boards of Directors of the ASRM and SART have approved this report.

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Optimizando la fertilidad natural: una opinion del comité.

Comité de práctica de la Sociedad Americana de Medicina Reproductiva y comité de práctica de la Sociedad de Endocrinología Reproductiva e Infertilidad

Esta opinión del Comité provee a los practicantes con sugerencias para optimizar la probabilidad de obtener embarazos en parejas o individuos que intentan concebir, pero quienes no tienen evidencia de infertilidad. Este documento reemplaza el documento con el mismo nombre previamente publicado en el 2013.