

the estrogen clock

It governs much of your life, in monthly and yearly cycles. And it has a profound effect on your health. Here's what to expect from the quintessential female hormone.

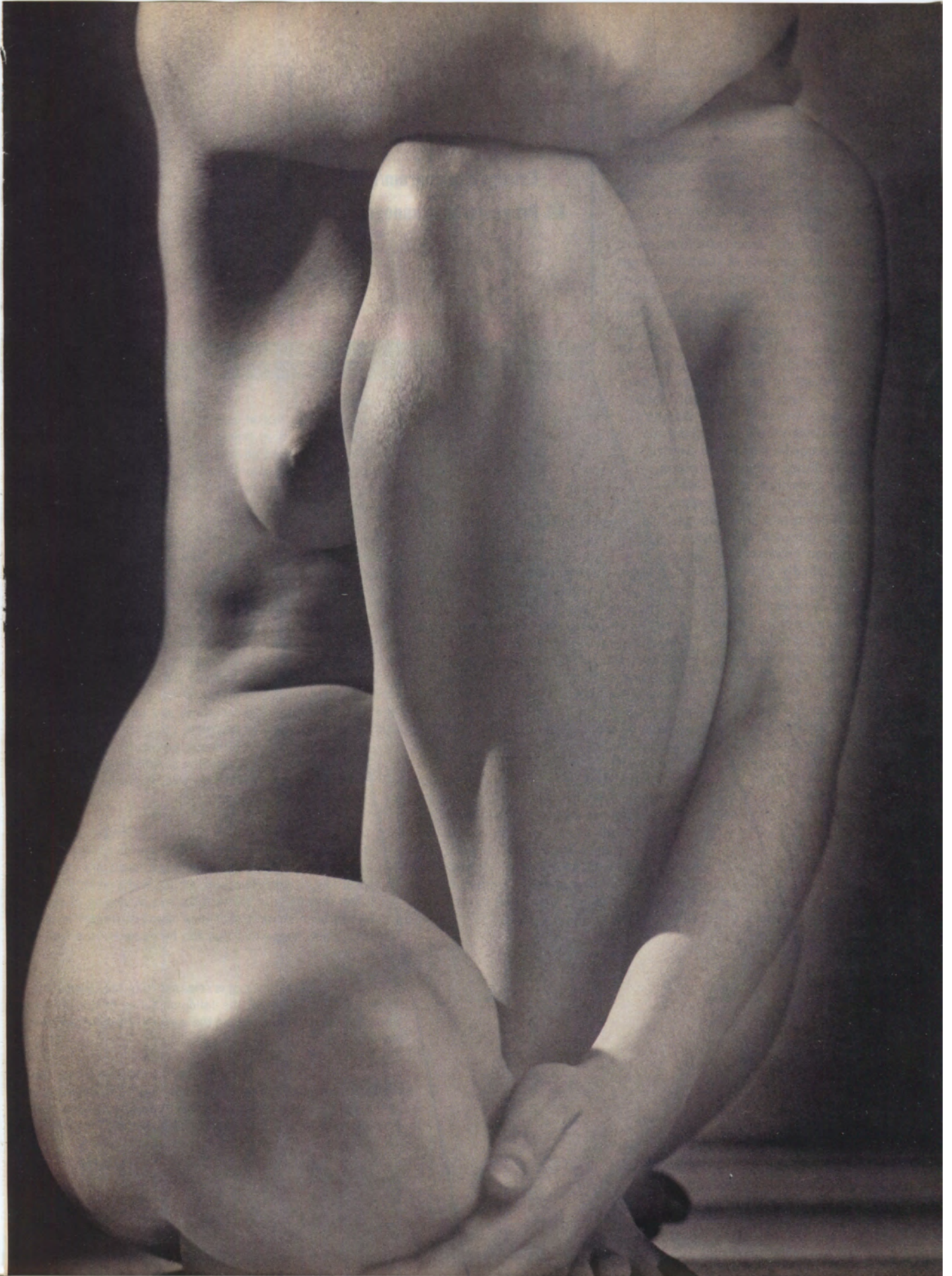
From puberty to menopause and beyond, the female hormone estrogen controls much of what it means to be a healthy, vital woman. While it is primarily the reproductive hormone regulating a woman's monthly cycle, estrogen has, over the past few years, been shown to perform an astonishing array of other critical functions in a woman's body. It helps to maintain bone density, promote a healthy heart, enhance sexuality and sharpen a woman's mental functions; it even fosters the dreams that researchers believe are important for restful sleep.

Estrogen, then, is key to a woman's health. But how

much is necessary, and when is it needed? These are questions that are now being asked most urgently by the countless women who are struggling to cope with life after menopause. This is when the body's need for estrogen is most glaring, as postmenopausal women suffer from osteoporosis, vaginal dryness, depression, weakened cardiovascular systems and the many other consequences of estrogen deficiency.

But the question might as well be asked by women before menopause. How do younger women know if their bodies are getting the estrogen they need? Estrogen levels rise and fall in two distinctive cycles—three if

by John Sedgwick
photograph by Ruth Bernhard



you count pregnancy. Most obviously, during the menstrual cycle, estrogen levels rise about tenfold around the time of monthly ovulation, only to subside again with menstruation. If pregnancy occurs, they soar up even higher, to more than five hundred times the prepregnancy peak—with extravagant mood swings and a generally jazzed-up feeling to show for it.

The lifelong cycle is another matter, and one that has been little investigated outside the moments of sharpest change, which occur at puberty and menopause. Like its monthly counterpart, this period has its own symmetry, as it takes about five years for estrogen levels to reach their adult level, and then another 10 years for them to dwindle back down again during menopause. In between those two climactic events, if the monthly variations were averaged out, a woman's estrogen level should stay "about the same," according to Pentti Siiteri, M.D., professor emeritus of obstetrics and gynecology at the University of California, San Francisco. Even at a constant level, though, estrogen interacts with other maturation processes to produce markedly different effects on a woman during different decades of her life. Although doctors rarely test for it, estrogen deficiencies or excesses at any of these phases have important health consequences. Here is a guide to estrogen's effects—both long-term and short-term—through the decades.

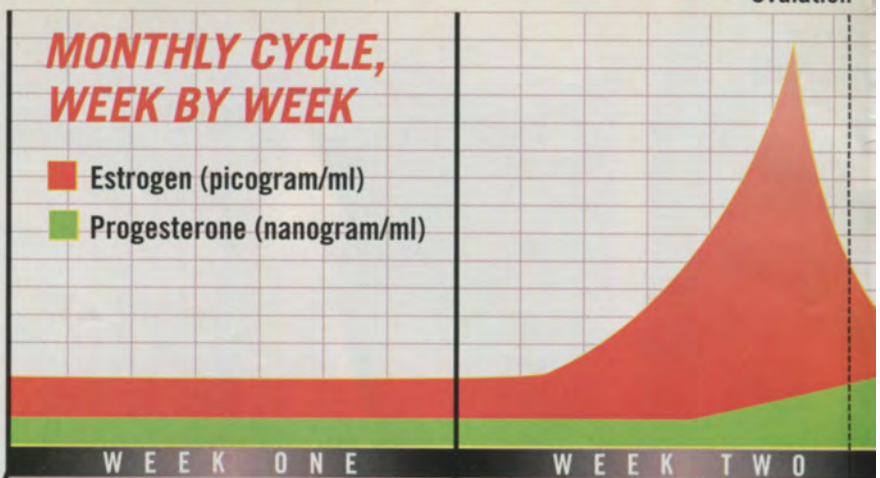
CRAMPS The discomfort that too often accompanies menstrual bleeding is not caused by hormones but by hormonelike substances called prostaglandins, which are produced by the uterus and are also responsible for labor pains. In the absence of ovulation, however, there are far fewer prostaglandins produced in the uterus and therefore less intense or no cramps. Since birth-control pills prevent ovulation, they are often used to treat bad cases of menstrual cramps.

MENSTRUATION Both estrogen and progesterone, which have built up throughout the cycle, drop to their lowest levels. If the egg is not fertilized, the lining of the uterus, which has been enriched in preparation for pregnancy, dies and is sloughed off. A typical period lasts five days. With estrogen and progesterone bottomed out, two other hormones—follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which are produced by the pituitary gland—begin the cycle by stimulating the maturation of another egg and starting estrogen and progesterone on their ups and downs.

ANOTHER CYCLE Scientifically speaking, the monthly menstrual cycle starts with the first day of menses and, on average, lasts 28 days, but it can vary from 20 days to 53. Any variation in length usually occurs during the first half of the cycle prior to ovulation, with the second half from ovulation till menstruation remaining relatively constant at 14 days.

MONTHLY CYCLE, WEEK BY WEEK

■ Estrogen (picogram/ml)
■ Progesterone (nanogram/ml)



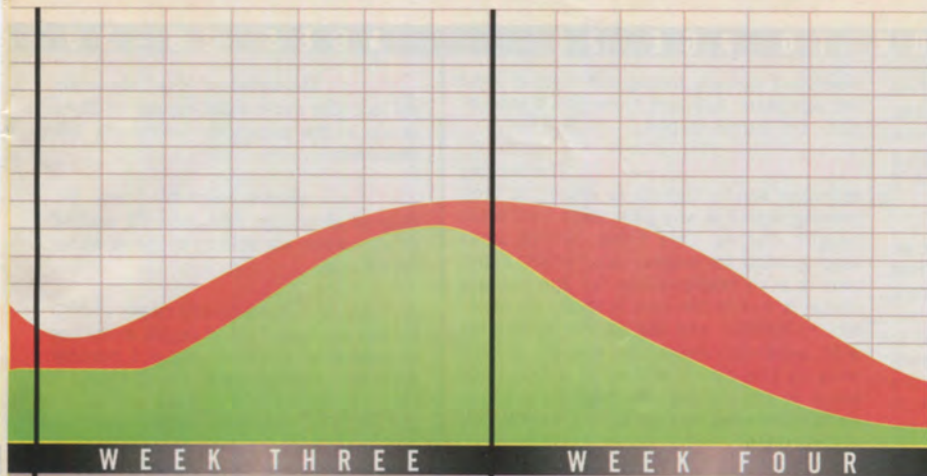
FERTILITY For purposes of procreation, sexual activity should begin two or three days before ovulation, which usually occurs on day 14. Since sperm can survive for several days in the uterus and fallopian tubes, an early start increases the chances of conception.

LIBIDO Research linking estrogen with human sexuality is sketchy, but rodents and non-human primates show a definite sexual response to the female hormone. Bruce S. McEwen, Ph.D., an endocrinologist at Rockefeller University in New York City, demonstrated that in rats, estrogen increases the number of synapses between the nerve cells of the hippocampus and those of the hypothalamus, which is responsible for sexual behavior, and, he says, "these connections come and go with the estrus cycle." Humans are more complicated, of course. But from an evolutionary point of view, it makes sense that, just as estrogen supplies the ability for a female to conceive at midcycle, it should also supply the desire.

EXTRA BRAINPOWER On tests of verbal articulation, perceptual speed and fine motor coordination, women do best when their estrogen levels are highest, according to Ann Hampson, Ph.D., and Doreen Kimura at the University of Western Ontario. A version of estrogen has been shown to enhance neurotransmitter activity in the brain, suggesting that the hormone is, in effect, a brain food.

OVULATION A mature egg is released from the ovaries and begins its journey down the fallopian tubes to the uterus. Should it encounter sperm on the way, fertilization can take place.

VAGINAL SECRETION The mucous membranes lining the birth canal are estrogen-sensitive, and they often produce a slippery, viscous secretion around the time of ovulation that may be intended to ease the passage of the sperm to the egg.



Estrogen is the elixir of femaleness. It sculpts our shapes, controls our fertility, even contributes to the way we think. And it is, like us, constantly changing.

BLOATING Estrogen's stimulation of blood flow, primarily in the breasts and uterus, contributes to midcycle weight gains. "Bloating is an engorgement phenomenon," explains Pentti Siiteri, M.D., of the University of California, San Francisco. "It results from water leaking out from the blood vessels."

POSTOVULATION Estrogen drops from its peak as progesterone levels rise sharply. Peak period of fertility. Progesterone anticipates fertilization and prepares the body for pregnancy.

BODY TEMPERATURE The rise of progesterone just after ovulation affects the brain's control of body temperature, causing the slight elevation that indicates to hopeful parents that ovulation has taken place.

APPETITE Estrogen is believed to be an appetite suppressant, which may be why some women report a weight gain in the latter part of the cycle, when progesterone counters estrogen's effects.

PREMENSTRUAL SYNDROME (PMS) As its name suggests, PMS usually occurs in the last stage of a woman's cycle, just before menstruation. Because progesterone levels drop during this phase, researchers have thought that it was responsible for the mood swings and irritability. (Oddly, progesterone has also been shown to be a powerful soporific.) The hypothesis has never been confirmed, however, and the debate still rages among endocrinologists about whether to blame estrogen or progesterone. Geoffrey Redmond, M.D., author of *The Good News About Women's Hormones*, suggests that it is not the presence of either hormone, but rather the absence of estrogen that is responsible. He suspects that as estrogen levels decline, they fail to stimulate enough endorphins, the body's own opiates, in the brain to keep a woman feeling good. Although progesterone has long been recommended for PMS, Dr. Redmond believes that for most women the best results are obtained from nonhormonal therapies, especially old-fashioned remedies like getting your rest, eating healthy, drinking plenty of water and avoiding stress. In some cases, he is willing to supplement this with a daily dose of an antidepressant, such as Prozac.

THE PILL AND YOUR CYCLE

When a woman decides to take birth-control pills—as nearly 80 percent of American women do at some point in their lives—three things happen in regard to her menstrual cycle. Her periods become startlingly predictable, she doesn't ovulate, and 99 percent of the time, she doesn't get pregnant. The reason for these powerful effects is, in a word, estrogen.

The most popular brands of the Pill are made of both synthetic estrogen and progesterone. In brief, the estrogen in the Pill works to trick the body into thinking it is already pregnant. The hormonal signals in turn prevent ovulation, and thus no egg is released from the ovary at midcycle. No egg, no possible fertilization of the egg. That's the birth-control effect.

As for menstruation, the combination of estrogen and progestin

allows the uterine lining to thicken and "prepare" for pregnancy in the first 14 days or so of the cycle. The difference is that in most cases it doesn't thicken as much as it would without the Pill. (That's one reason why Pill periods are typically lighter.) In regard to safety, many women still worry about the long-term impact of "adding unnatural estrogen" to their bodies, that it might result in higher rates of breast or other cancers. The truth is, today's pills are often called "low dose" because they contain as little as 30 micrograms of estrogen—less than a third of the amount that was in the Pill of the 1960s—and less than 1 milligram of progestin. In fact, the most clear-cut benefit of the Pill—other than contraception, of course—is its prevention of cancers of the reproductive tract.

DEVELOPING FEMALENESS For the first few weeks in the womb, all fetuses are female. The fetus begins its transformation to a male about two months after conception, when a surge of testosterone is triggered by the Y chromosome.

PREPUBERTY Girls do not experience an equivalent surge of hormones until the first stirrings of puberty at about age eight, when, for reasons that probably have to do with nutritional status, the ovaries are provoked to start producing estrogen. Although these early hormone levels are still relatively low, the young girl begins to grow breast buds, which amounts to a slight buildup of mammary tissue under the nipple.

MENARCHE, or first menstruation, now occurs on average at 12½, an age that has been falling steadily over the past two centuries, most likely due to improved nutrition. Poor nutrition or excessive exercise can delay it. Estrogen levels rise to a monthly average that will be sustained for the next 30 years.

PERIODS at first vary wildly and will take, on average, five years to become fully regular.

LIBIDO As the current high rates of teenage pregnancy show, girls are fertile and fully

developed sexually throughout most of their teenage years. Estrogen alone is not responsible, but it does its part.

BODY SHAPE AND BREASTS The surging estrogen sends signals to bones to stop growing, which is why girls reach their adult height during this time, while boys keep growing for several more years. Estrogen is also responsible for the female shape: It directs the hips to widen (to facilitate childbirth) and the breasts to enlarge with expanded mammary glands. It also ordains the development of pubic hair, which is not literally new hair but a thickened, darkened version of the downy hair already there.

FERTILITY Estrogen enlarges the uterus, making it capable of sustaining a pregnancy.

ACNE It is the companion hormones, the androgens (yes, women produce male hormones) that cause the skin oiliness and acne that plague girls and young women. Excess androgens can also cause unwanted hair in the "male" areas of the chest and face. These conditions can be treated with birth-control pills, whose estrogen supplements can counter the androgens.

PERIODS Menstruation is usually heaviest and the cycle most regular in these years, as the adolescent irregularity settles down.

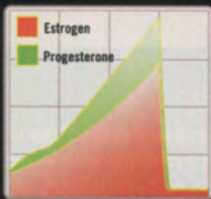
FERTILITY Women reach their peak fertility at about age 24, when 75 percent of all women are able to conceive within six months.

BONE LOSS Bone density peaks when a woman is about 25 and begins to decline thereafter at a rate of about 1 percent every year. Estrogen helps slow the loss.

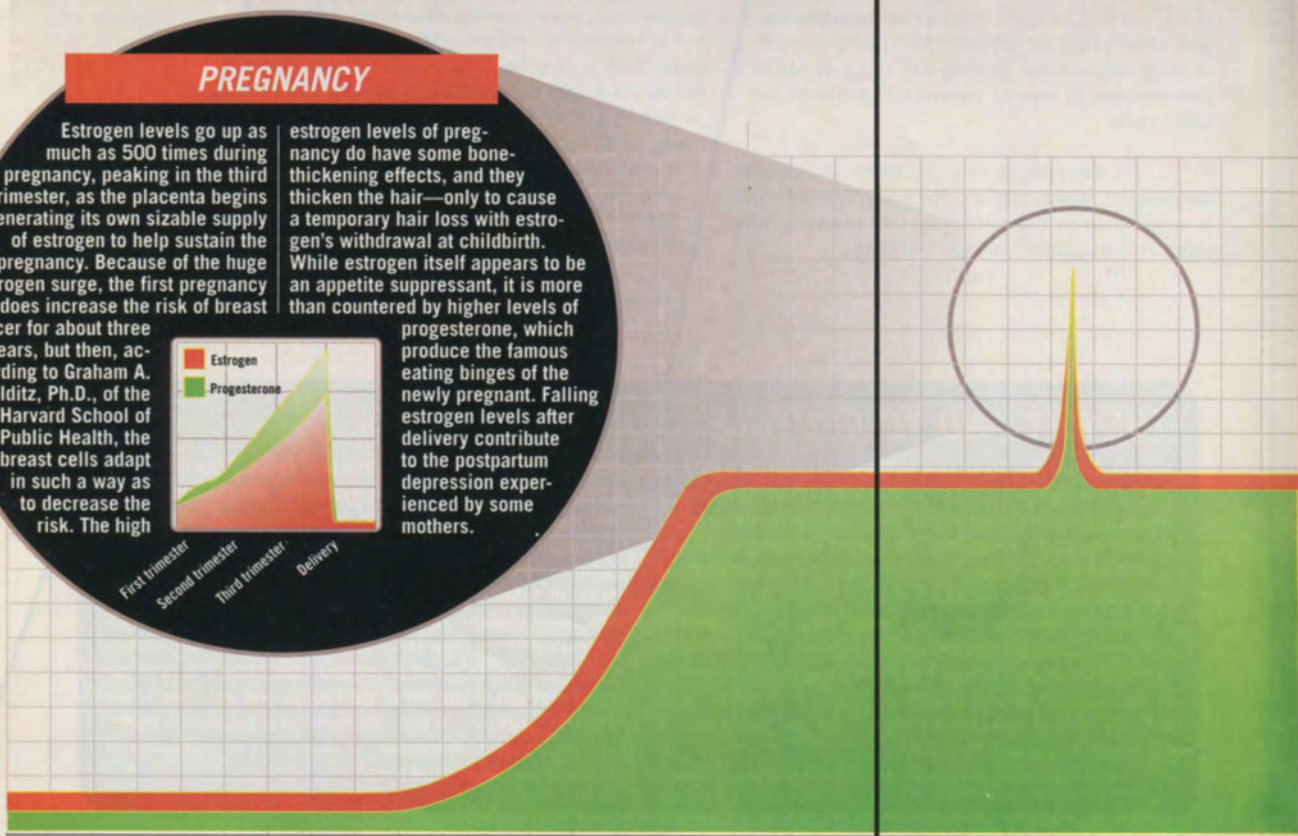
EXERCISE Women who exercise extremely hard for long periods of time may stop having their periods; even if they don't stop menstruating altogether, they can suffer from an estrogen deficiency that causes their bones to decay prematurely. "Sometimes, their bones are like a 70-year-old woman's," says J. Christopher Gallagher, M.D., an endocrinologist at Creighton University School of Medicine in Nebraska.

PREGNANCY

Estrogen levels go up as much as 500 times during pregnancy, peaking in the third trimester, as the placenta begins generating its own sizable supply of estrogen to help sustain the pregnancy. Because of the huge estrogen surge, the first pregnancy does increase the risk of breast cancer for about three years, but then, according to Graham A. Colditz, Ph.D., of the Harvard School of Public Health, the breast cells adapt in such a way as to decrease the risk. The high



estrogen levels of pregnancy do have some bone-thickening effects, and they thicken the hair—only to cause a temporary hair loss with estrogen's withdrawal at childbirth. While estrogen itself appears to be an appetite suppressant, it is more than countered by higher levels of progesterone, which produce the famous eating binges of the newly pregnant. Falling estrogen levels after delivery contribute to the postpartum depression experienced by some mothers.



AGES 30 - 40

PERIODS will grow progressively shorter and lighter through the decade, although it is the phase after ovulation that will be truncated, with a slight loss of progesterone being the primary consequence.

PREMENSTRUAL SYNDROME (PMS) is most common in the thirties.

FERTILITY Between the ages of 35 and 39, the chances of conceiving within six months have dropped to 25 percent, a result of conditions like endometriosis and natural aging that become more problematic as a woman gets older.

LIBIDO There is little scientific evidence that women's sexual desire reaches a lifetime high during this period, as the folklore would have it. It is more likely that women have simply maintained their level of sexual interest whereas men have lost some of their physical passion. Should a woman's sex drive decrease, androgens are more likely than estrogen to be blamed. Falling androgens can also cause pubic hair to thin.

MOOD Some thirtysomethings complain of menopausal-like mood swings, sensitive skin and a general achiness that Geoffrey Redmond, M.D., believes is a result of estrogen deficiency, although he says the problem is often misdiagnosed. A rare menopausal-like disorder called premature ovarian failure may be causing the symptoms. It can be treated with hormone replacement therapy (HRT) to make sure the bones and heart continue to have estrogen's protection.

AGES 40 - 50

PERIODS Menopause is generally preceded by a five-to-10-year stretch called perimenopause in which the menstrual cycle becomes erratic, often annoyingly so. (If you want to know if menopause is imminent, have your level of a hormone called FSH tested; the higher it is, the sooner menopause will arrive.)

FERTILITY Only 23 percent of all women are able to conceive within six months after age 40. Still, the rate of abortions for thirtysomethings is second only to that of teenagers. As your periods become erratic, it can be difficult to tell whether you are pregnant.

PMS Many women find themselves experiencing accentuated symptoms—chiefly moodiness and irritability. HRT is not recommended for PMS, but birth-control pills can offer some relief because they restore diminishing estrogen. Some women are helped by taking a variety of "natural estrogens," such as ginseng and sage. Vitamin E may ease the hot flashes.

BODY SHAPE With declining estrogen, fat is no longer directed to the breasts, thighs and buttocks but is spread more evenly as a general pudginess around the body.

50 AND BEYOND

PERIODS Menopause usually comes around age 52, a time that, curiously, has remained unchanged even as the age of menarche has shifted downward. Only heavy smoking has been shown to lower the age of onset by as much as five to 10 years. With menopause, the ovaries shut down, estrogen levels drop to about 25 percent of the premenopausal supply, and the waxing and waning of hormone levels that characterized the menstrual cycle stop altogether. The adrenal glands continue to secrete the hormone, and there is a small amount stored in fat cells, but most men over 50 have more circulating estrogen than postmenopausal women do. And obese women have considerably more estrogen than thin women.

ESTROGEN DEFICIENCY A shortage of estrogen can have a profound impact on a woman's overall health and on her quality of life. It can bring on hot flashes and night sweats, cost the skin its richness and luster, trigger depression and ruin a woman's sex life because the vagina shortens and its lining slims to a papery thinness. Many physicians now recommend that postmenopausal women take hormone replacement therapy, usually a combination of estrogen and progestin (synthetic progesterone). Still, most women stay on HRT for no more than a year, often because they are unhappy with the physical and emotional side effects, which include depression and edginess.

Dr. Redmond thinks these problems occur because most women may not be taking enough. "The doses to protect your heart and bones are much lower than the ones to maintain your well-being," he says. In any case, the dosages need to be calibrated with care. It may be that older women can safely take less, but the research needed to decide the matter is not yet complete. HRT is most protective against the following illnesses:

Osteoporosis The process that begins when a woman is 25 can become quite severe after menopause, resulting in dangerously thin, brittle bones. As it is, the collapsing of vertebrae alone can cause women to shrink by as much as an inch every two to three years.

Heart disease Even though some worrisome studies have shown that estrogen increases the risk of breast cancer, the reduction in heart disease drives down death rates for women so substantially that the benefits of HRT appear to far outweigh the liabilities. Many researchers now recommend that only women who are at very high risk for breast cancer should worry about taking HRT.

Alzheimer's disease "What I tell my women friends is that the Alzheimer's connection is one more reason to take HRT," says Bruce S. McEwen, Ph.D., who has done much of the pioneering work to implicate estrogen deficiency in Alzheimer's.

LIFETIME CYCLE, DECADE BY DECADE

■ Estrogen (pg/ml)
■ Progesterone (ng/ml)

