NATURAL FAMILY PLANNING: A REVIEW

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INTRODUCTION

Periodic abstinence along with withdrawal are the oldest family planning methods. With the introduction of barrier contraceptives beginning in the mid-19th century, intrauterine devices at the beginning of the 20th century, and the oral contraceptives in the 1960's, natural methods were overshadowed by the highly focused and well-financed methods of dissemination of technological methods of contraception. According to the Demographic and Health Survey of 1993, globally 49% women aged 18-44 used reversible or permanent contraception, while 14% used some form of periodic abstinence.[1] [Some users of withdrawal may have been included in the latter group.]

In the United States, the National Survey of Family Growth, 1990 reported 59.2% contraceptive prevalence in women 15-44 years of age. Of these, 2.3% used calendar rhythm, while 0.37% used either cervical mucus and/or temperature methods. Thus 1,558,000 women/couples used natural family planning in the U.S. in 1990. Among these, the proportion of Roman Catholics was disproportionately high - 47-48%.[2]

Definition

Natural family planning is planning to achieve or avoid a pregnancy by the timing of intercourse. By observing and recording certain natural symptoms and bodily changes that occur in a woman's menstrual cycle and using the information as a guide, a couple can learn to identify fertile and infertile phases in the menstrual cycle. If the couple wishes to achieve pregnancy, they can be aware of the best days for this to occur. If the couple wishes to avoid pregnancy, they must abstain from intercourse or genital contact during the fertile or risk period of the cycle. Natural family planning for avoiding pregnancy is also referred to as "periodic abstinence".[3] The World Health Organization (WHO) definition of periodic abstinence is voluntary avoidance of intercourse by a couple during the fertile phase of the menstrual cycle in order to avoid pregnancy.[4]

Reproductive Physiology

For untold generations, women the world over have intuited that they were not always fertile. Some tribes correctly associated the mucus at the vulva with fertility, but scientific investigation of fertility only began with Von Baer's description of the mammalian ovum in 1827. Pouchet described inter-menstrual pain and cervical mucorrhea in 1847; the biphasic temperature curve of women was first discovered in 1877 by Jacobi, but was not conclusively related to ovarian activity until van de Velde's demonstration in 1905 and Hansen's in 1913. Clinical application of these findings were not made until the mid 1930s.[5]

Biochemical and Biophysical Correlations of Fertility Signs

Casey[6] found the mean LH surge-ovulation interval to be 16 hours, while Croxatto et al.[7] report a 17-hour interval based on his own and other studies. There is less agreement on the fertilizable life of the ovum after ovulation. Estimates vary from 6 to 24 hours. Moghissi's estimate of 6 to 8 hours is the lowest.[8] WHO estimates 8 to 12 hours,[4] Blandau believes that ova cannot be fertilized successfully beyond 15 to 18 hours,[9] while Pritchard and McDonald cite 24 hours.[10] Index studies are shown in Table 1.

Ova which have not been fertilized have been recovered from the tube and endometrial cavity up to 144 hours after ovulation as determined by LH peak.[7]

Echographic study of follicular maturation and ovulation during the menstrual cycle afforded the first opportunity to visualize the developing follicle non-invasively. Renaud et al.[15] had used the technique since 1976 to monitor ovulation induction. In 1979 he studied 10 normally cycling women, correlating the ob-

TABLE 1
Significant studies relating the changing cervical mucus to the hormone of the menstrual cycle

	Duration (days) from onset of mucus til			
	Estradiol peak		LH peak	
Parameter of mucus observation	Mean	Range	Mean	Range
Billings et al.[11] (self-observation)	5.2	4-9	6.2	1-3
Moghissi el al.[8] (fern assays)	NA	2-4	2-5	-2-+2
Flynn and Lynch[12] (self-observation)	3.0	2-5	3.5	1-7
Hilgers and Prebil[13] (self-observation, fern and channel)	5.6	-0.31	-2-+2	
Morishita et al.[14] (>0.1 ml mucus)	1.4+0.2	1-2	1.8±0.2	1-3
Renaud et al.[15] (cervical index, follicle disappearance)	1	1-2	1	1-2

served follicular development with recording of the basal body temperature, measurement of plasma LH, 17 ß-estradiol, and progesterone, and with the visual appearance of the cervix and cervical mucus, evaluated according to the criteria and scoring system of Insler and Lunenfeld.[17] Maximal LH level was achieved in seven of 10 women on the day prior to echographic follicular disappearance, and in three of 10 women on the day of disappearance of the follicle. Thermal shift occurred on the day prior to follicular disappearance in five of 10 cycles, on the day of disappearance of the follicle in four cycles, and 1 day later in one cycle. Maximal cervical score was found 1 day prior to follicular disappearance in five women, and on the day of follicular disappearance in four.

O'Herlihy found similar correlation in one case, which utilized the "peak mucus" rather than the Insler and Lunenfeld cervical score.[18] More recently, Billings found that the cervical index did not reflect hormonal parameters as accurately as mucus alone when cervical mucus was correlated with the follicular diameter and studies of serum LH and urinary pregnanediol.[19] Echographic correlations of changes in cervical mucus, ovarian and pituitary hormones were confirmed by R.E.J. Ryder.[20]

The Hormonal Cascade of Ovulation

Our current recognition of the fertile phase is based upon a prospective understanding of the physiology of ovulation. At birth, the girl's ova are in the diplotene stage of development. They either remain quiescent or undergo atresia until puberty when some oocytes will mature and complete their meiotic division. The dominant follicle is selected within the first few days of the cycle by a rise in follicle stimulating hormone (FSH). FSH stimulates the granulosa of the healthy follicle to produce estrogen and follicular fluid to form antral follicles. Estrogen is produced by aromatization of androgens within the ovary. Antral follicles with the highest concentration of granulosal proliferation contain the highest estrogen concentrations. These have the lowest androgen/estrogen ratios and are most likely to house a healthy oocyte. In the antral follicle, LH (luteinizing hormone) receptors are present only in the theca cells, while FSH receptors are present in the granulosa. LH stimulates the theca to produce androgens which can then be aromatised to estrogens. Estrogen exerts a negative feedback onto pituitary FSH production, which in turn causes withdrawal of gonadotropin support from the less well developed follicles which had begun to develop at the beginning of the cycle, causing a decline in their aromatase activity and limiting estrogen production in those follicles. The dominant follicle reaches a maximum diameter of 19.5-25 mm prior to ovulation. The granulosa cells begin to acquire LH receptors. Prior to ovulatory stimulation by LH, the concentration of estradiol must be over 200 pg/ml and must be sustained for at least 50 hours until the LH surge has occurred. GnRH (gonadotrophin releasing hormone) pulsatile release from the hypothalamus is present throughout the cycle, but is characterized by shorter pulse intervals and smaller pulse amplitudes in the follicular, as opposed to the luteal phases of the cycle.[21] Following ovulation or perhaps 24 hours prior to it, luteinization of the follicle produces progesterone, which in turn causes the well known conversion of endometrium to the secretory phase, suppresses cervical mucus with fertile characteristics to be described subsequently, and raises the basal body temperature.

TABLE 2
Median time intervals in hours from the hormonal event to ovulation at 95 per cent confidence limits[16]

	Ovulation	
Hormone	Rise (hours)	Peak
17 ß-estradiol	82.5 (54.0-100.5)	24.0 (16.9-32.1)
LH	32.0 (23.6-38.2)	16.5 (9.5-23.0)
FSH	21.1 (14.1-30.9)	
Progesterone	7.8 (-12.5-15.9)	

Cervical Mucus

The prediction of ovulation has been facilitated by the recognition that a threshold level of estrogen from the ripening follicle is required for the onset of fertile cervical mucus production. Each woman has her own threshold level, a significant rise from the baseline which signals the beginning of follicular ripening. Brown has identified the usual threshold at 15-20 µg per 24 hours.[22] A colloquium on cervical mucus in human reproduction was convened by WHO in 1972. The state of knowledge of the morphology of the cervix, the ultrastructure of cervical mucus, as well as its biochemistry and penetrability to sperm in relation to estrogen-progesterone balance, was well-documented.

There was complete agreement that cervical mucus reaches maximum spinnbarkeit and ferning, as well as its lowest cellular content, at the time of the LH peak and changes abruptly as progesterone levels rise above baseline. Cervical mucus is a hydrogel, comprised of a high-viscosity (gel phase) and low-viscosity component. The low-viscosity component consists mainly of electrolytes, organic compounds of low molecular weight such as glucose and amino acids and soluble proteins. The high-viscosity component consists of a macromolecular network of mucin which mainly determines the rheological properties of the mucus.[23]

Erik Odeblad has studied the cervical mucus since the late 1960s with nuclear magnetic resonance, electron and light microscopy, crystallography and electron spectroscopy for chemical analysis (ESCA). He has demonstrated not only unique crystalline structure, but unique chemical compositions in each type of mucus. By developing a micro-NMR method which could be applied to study the minute amounts of mucus produced by a single cervical crypt, Odeblad found that the cyclical variation in mucus is due to the fact that different crypts are active during different phases of the cycle. In 1968, G mucus (produced by progesterone stimulation) was identified; in 1977 and 1978 the L and S mucus were shown to be due to estrogen. Most recently, P mucus and F mucus have been identified. NMR depends on recognition of the shape, spin, and magnetic properties. The chemical composition and viscosity of the various mucus forms have been studied and described in detail. NMR, ESCA crystallization and polarized light studies, pH and optical measurements have helped augment knowledge about cervical function. The studies confirm that:

1) Cervical mucus is a dynamic system, composed of G, L, S, and P mucus (hydrogels), produced in separate crypts in adequate proportions, varying cyclically.
2) The organic constituents of the secretions are different as visualised by NMR, spectroscopy and optical studies.
3) The water binding (hydration) in the four mucus types are of different kinds and strength (from NMR shifts and T_1 studies).
4) The concentrations of Na, K, Cl and Ca ions are different in the four mucus types. There is evidence that the first three ions are bound to mucins or proteins in varying extent.
5) Supplementary studies with ESCA indicate that Mg and Zn have different concentrations in the four mucus types. ESR studies also show that Cu, Fe and Mn have very low concentrations.
6) The difference in Na and K concentrations in S and P mucus give rise to concentration gradients which may favor sperm transport in the upper cervix. Rheological factors may aid low-quality sperm to enter the micropockets of L mucus and be removed (sperm selection).
7) Optical studies with polarized light indicate that the P mucus exhibits molecular symmetry properties which may explain how it reduces the bulk stretchiness and also make an additional sperm selection based on chirality of sperm tail motion.
8) pH indicator observations may help to distinguish quickly between L and S crypts, aiding reconstructive microsurgery of S-crypt atrophy in post-pill infertility.

G- mucus is produced in response to low levels of adrenal progesterone. After ovulation, G+ mucus is found in sufficient quantities to leave the cervix and be detectable at the vulva. Estrogen rise initially triggers the production of L mucus which appears as loaf-like structures on the strands of S mucus and selects out imperfect sperm forms. A higher level of estrogen produces the S (or string) mucus which conducts sperm into the higher S crypts of the cervix. The S mucus nourishes the sperm in the crypts. P mucus is produced + or - 36 hours of estrogen peak. At least two forms of P mucus exist: P_6 mucus, which conducts sperm cells from the S crypts into the uterine cavity and P_a mucus, which has a mucolytic function due to adhesion of mucolytic grains originating from isthmus. It serves to open the barriers at the mouths of the S crypts to release the sperm at the time of ovulation. In addition, fetal cells which line the cervical canal produce a baseline discharge without lubrication - F mucus, in some women. As yet, no clinical significance has been discovered for F mucus.

Figure 1 (shown on page 4) shows the sites of mucus producing crypts. Figure 2 (shown on page 4) shows the proportions of mucus types throughout the cycle. Figure 3A shows the path of mucus production in the cervix and reabsorption in the vagina. Figure 3B (shown on page 5) correlates the site of mucus production in the cervix with its appearance at the vulva. Figures 4A-7B (shown on page 7) show the microscopic structure of dry G-, L, S, P_a, P_6, G+, F and Z mucus in spread-out and dried cervical specimens with interference contrast microscopy without any staining.

The L, S, and P mucus types are embraced in the older notation E (estrogenic) mucus.

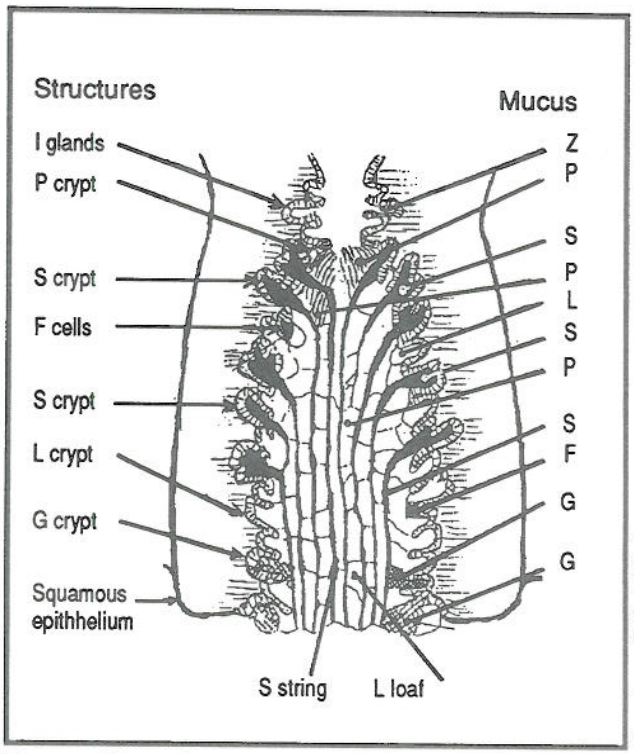
The mucolytic activity of P_a mucus alters the S-mucus and reduces its elasticity while increasing its wetness, thus many women report a sense of soapiness at the vulva when P-mucus is present. At the same time, the mucus may be so fluid, that its amount appears to be reduced.

Barriers to Sperm Entry

The intermicellar spaces of G mucus are smaller than the diameter of the sperm head making it a sperm barrier. G mucus contains three cell types: epithelial, leucocytes (PMN), and lymphocytes. Their proportions vary considerably, generally 50% of the cells are epithelial; the other half are divided between the PMN leucocytes and lymphocytes. If there is local or general inflammation, the proportions of cells are affected.

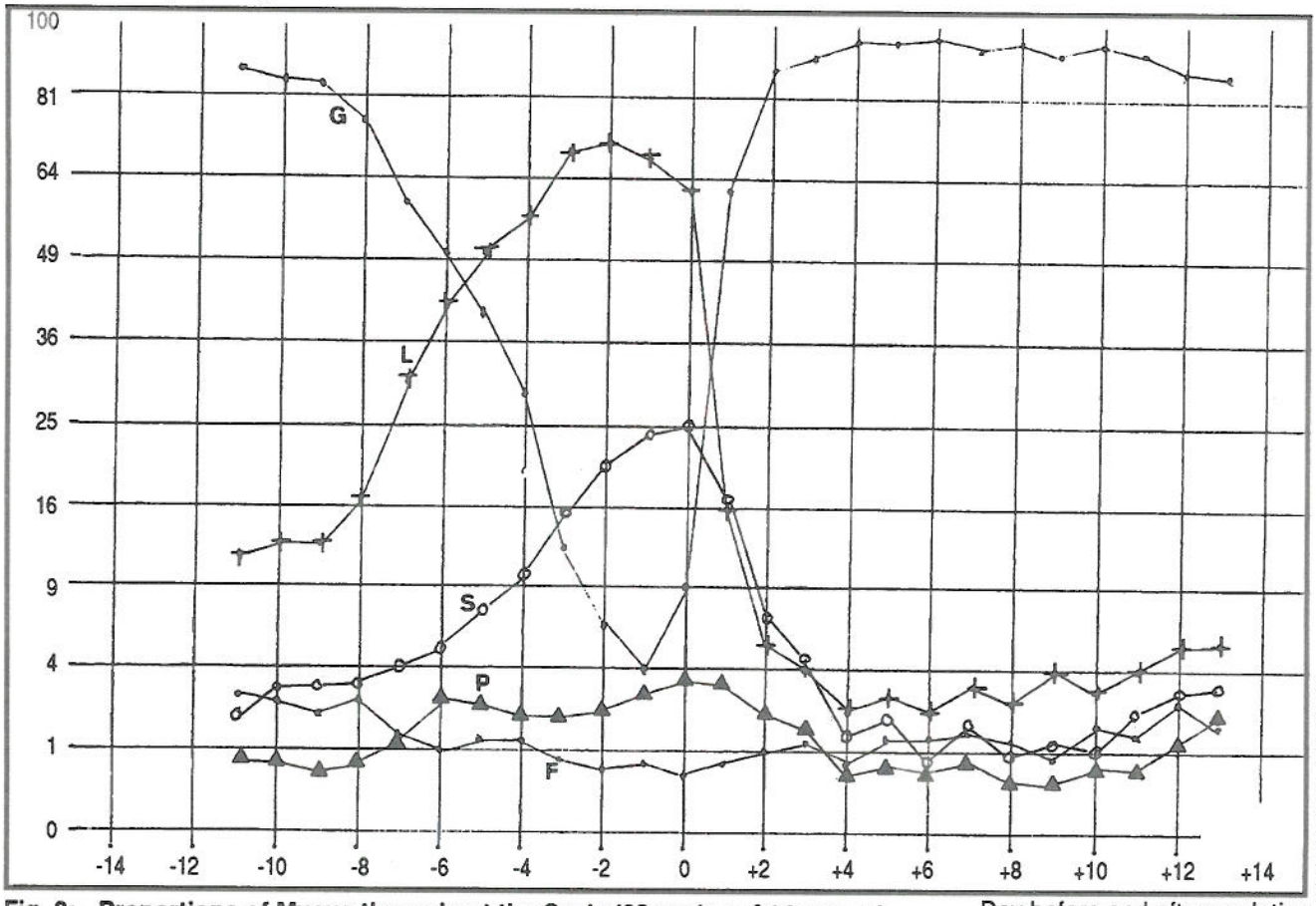
Aging of the Cervix

Odeblad has also shown that the cervix ages naturally from birth until post-menopause. Around puberty S crypts are very numerous, but with advancing age, L crypts replace S crypts, while there is in-



(courtesy E. Odeblad)

Fig. 1: Sites of Various Mucus Producing Crypts



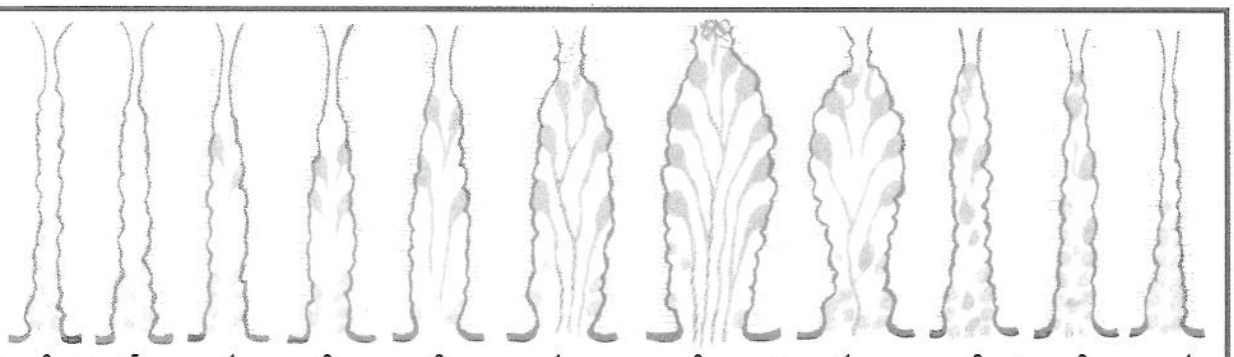
(courtesy E. Odeblad)

Fig. 2: Proportions of Mucus throughout the Cycle (23 cycles of 14 normal women, aged 28-32 years with 2-3 children each)

Anatomy	Secretion Absorption Sensation			
Pockets of Shaw Mn secretion, mucus coagulation, water reabsorption. Cervical crypts	Small amount of secretion Mn is secreted Mucus coagulates, is reabsorbed No mucus sensing site	Moderate amount of L-type secretion, increasing Some Mn secretion but some mucus can reach the sensing site	Large amounts of mucus types L, S, and P No Mn secretion No coagulation All mucus reaches sensing site	Moderate amount of G-type secretion Mn is secreted Mucus coagulates no mucus reaches sensing site
				
Site of sensing the mucus symptom	No sensation of mucus	Mucus symptom with thick, tacky mucus	Mucus symptom with wet, slippery or lubricative, stretchy mucus	No sensation of mucus
	First infertile day	The mucus symptom	Peak day	2nd infertile Period

(courtesy E. Odeblad)

Fig. 3A: Correlation of Mucus Production and Reabsorption with Vulvar Sensation



	-6	-5	-4	-3	-2	-1	0 PEAK	+1	+2	+3	+4
		Mucus Symptom									
Sense-tion	Dry	Wet sticky	Wet sticky	Wet slippery	Wet slippery	more wet very slippery	Very Wet very slippery	Nearly dry dry	Dry	Dry	Dry
Amount	No	Small	A little more	More	large	Very large	Smaller amount	Very small	No	No	No
Strechi-ness	No	Small	A little more	More	Long	Very long	Shorter	Very short	No	No	No
Chart											
Phase	Infertile	F E R T I L E									Infertile

(courtesy E. Odeblad)

Fig. 3B: Mucus Production at Different Sites (or crypts) in the Cervix and Appearance of Mucus at the Vulva

creasing invagination of squamous epithelium from the portio vaginalis which may even ascend the cervical canal. Pregnancy stimulates production of S crypts and rejuvenates the cervix by two to three years, while oral contraceptives double the functional rate of aging of the cervix. After menopause, the entire endocervix undergoes squamous metaplasia. Table 3 (below) shows these functions most accurately.

Role of the Vagina

Fluid secreted by the upper third of the vagina produces a mucus-like discharge made up of membraneous glycoproteins (glycocalix) derived from the intermediate cells of the vaginal epithelium. It contributes to the presence of "mucus" on infertile days. Ordinarily the fluid is reabsorbed in the lower third of the vagina by the surface epithelial cells which contain manganese. These are particularly plentiful in the pockets of Shaw — two areas lateral to the urethra. When estrogen is high the thickness of the vaginal epithelium increases which blocks manganese and fluid reabsorption. Thus, mucus and fluid easily reach the introitus and is recognized as the mucus symptom. Once progesterone dominates the hormonal balance, manganese reappears and begins to absorb cervical and vaginal fluid.[24] (see figures 3A and B, shown on page 5)

Sperm Viability

The fertilizable life of spermatozoa is the least known component of the triad of fertility: ovum, cervical mucus, and sperm. Any conference on the subject generally includes a reference to the Psalmist's "every man is a liar," indicating the difficulty in obtaining accurate histories of coital activity, and the ethical problems which generally preclude experimentation. The phases of sperm life, aging of the germ cell, aging of the epididymal cell, and aging of the ejaculated sperm in the female tract, are of practical importance.[25] The discussion of the advisability of conception by older parents has been preempted by the geneticists. Aging of the epidydimal cell can be manipulated by the frequency of intercourse.

The critical question for natural family planners is sperm survival in the female tract. The pH of the vagina is acid; hence, sperm die quickly, some say between 4-6 hours;[26] others claim 30 minutes. Sperm are morphogically detectable in the vagina up to 48 hours after intercourse.[27] Settlage et al. confirmed that sperm transport into and within the cervix is contingent on the hormonal cycle. When the mucus is highly estrinized, sperm enter the cervical crypts within 5 minutes, and not beyond 15 minutes.[28] Odeblad reported nonmotile sperm in the S mucus of the cervical crypts when the crypts were aspirated with a micropipette. When the sperm were returned to string mucus, they regained their motility.[29] Settlage has identified sperm in the oviduct within 15 minutes from deposition in the proximal vagina.[28] During lactation sperm entry into mucus has been reported by Vigil *in vitro*. See Lactation on page 14.

Table 3
Some physical, chemical and biological properties of the various cervical secretions and of secretions of the isthmus and the vagina after Odeblad

Mucus Character	G-	G+	L	S	P_6	P_a	F	Z	"Vaginal Mucus"
Place of biosynthesis in cervix	Lowest third	Lowest third	All cervix	Upper cervix	Upper fifth	Upper fifth	All cervix	Isthmus	Vagina
Hormonal and other stimulation	Low progesterone	High progesterone; interleukin 1	Ave. and increasing levels of estrogen	High estrogens; noradrenaline	High and decreasing estrogens; noradrenaline	High and decreasing estrogens; noradrenaline	Probably none	Probably none	Low and ave. levels of estrogen
Av. viscosty by NMR; (95% interval)	11 (6 to 17)	30 (15 to 45)	3.5 (2.4 to 5)	1.3 (0.9 to 2.2)	2.0 (1.4 to 3)	2.0 (1.4 to 3)	7 (2 to 11)	1.5 (1 to 6)	5 (2 to 10)
Apparent viscosity	High	Very High	Medium	Fluid	Fluid	Fluid	Medium	Commonly fluid	Low or Medium
Function in ascent of spermatozoa	Barrier to sperm advancement	Barrier to sperm advancement	Attracts malformed sperm	Conveys normal sperm to the crypts	Conveys normal sperm to the crypts upward	Aborbs Z secretion and performs mucolysis	No known function	Various enzymatic activities	-
Presence during cycle	First infertile phase	Second infertile phase	Fertile phase	Pre-ovulatory phase and Peak day	Beginning of the fertile phase	Beginning and end of the fertile phase	Throughout cycle	Probably throughout cycle	infertile phases
Sensation at the vulva	Dry	Dry	wet, stcky	Wet, lubricative	At peak day wet and very lubricative	Loosens plug. Wet and very lubricative	Sticky	Wet	flaky
Apprx. time for mucolysis	24 hours	36 hours	5 hours	5 hours	15 hours	15 hours	24 hours	-	36 hours

(courtesy E. Odeblad)

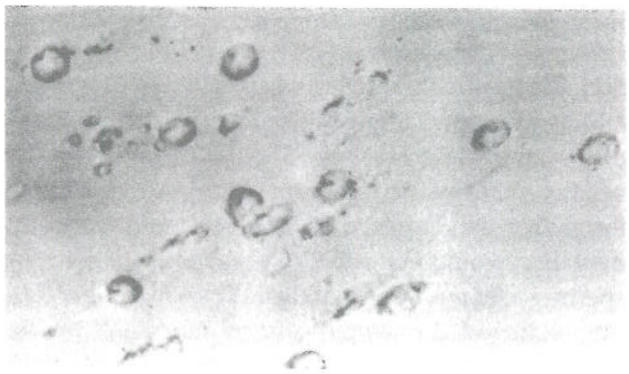


Fig. 4A: G- Mucus, Leucocytes (round) and Epithelial Cells (elongated) x 1000

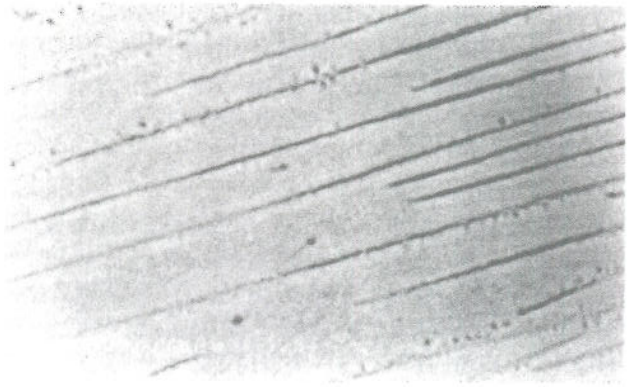


Fig. 5A: S Mucus with Sperm (post-coital test) x 200

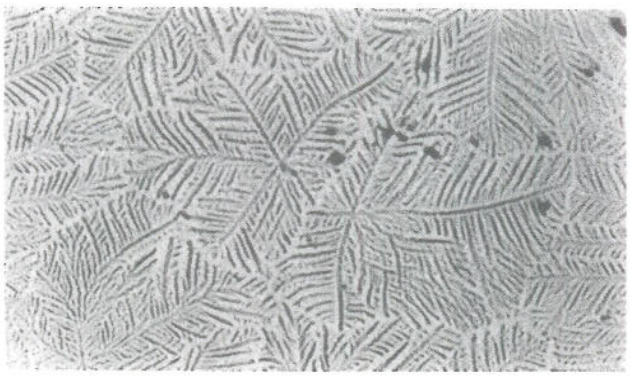


Fig. 6A: P_s Mucus (Hexagonal Star) x 200

Fig. 7A: F mucus (epithelial cells only) x 1000

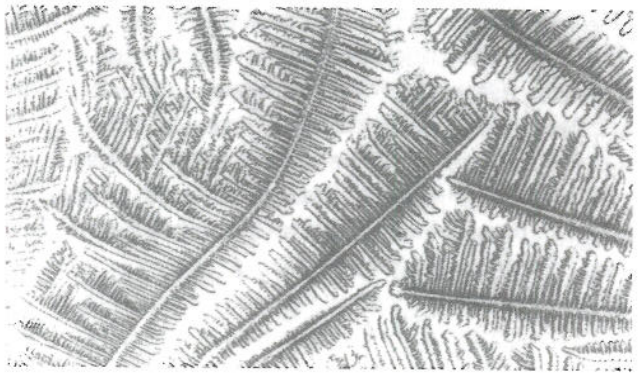


Fig. 4B: L Mucus x 100, Tetragonal Crystals

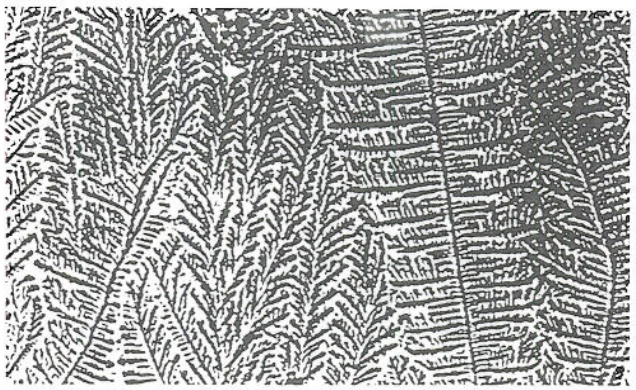


Fig. 5B: P_a and L mucus x 200

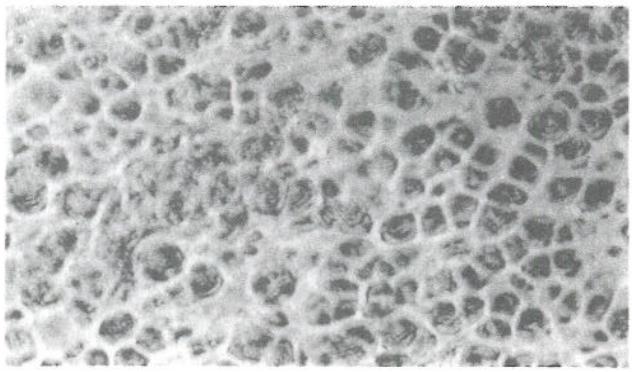


Fig. 6B: G+ Mucus, mainly Leucocytes x 1000

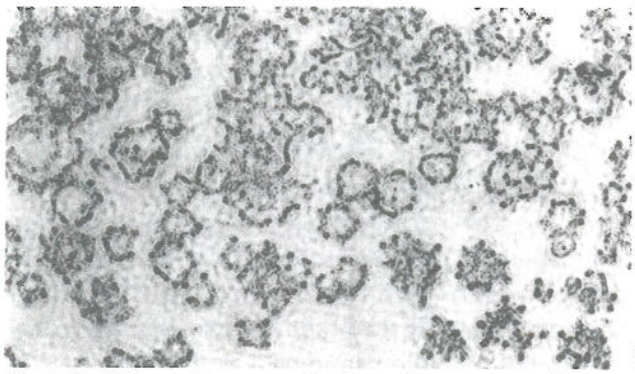


Fig. 7B: Z Secretion mucolytic grains arranged in rings x 1000

(figures 4A-7B, courtesy E. Odeblad)

Analysis of clinical material has led natural family planners to conclude that coitus prior to onset of estrogen rise in the cycle rarely, if ever, results in pregnancy. The cervical mucus acts as a biological valve admitting sperm readily during its estrinized phase, and acting as a barrier to sperm entry during the progestational phase. (See Odeblad's analysis of mucus, Table 3) During the "fertile (estrogenic) phase" of the mucus, experience has shown that coitus up to 5-6 days before peak mucus can lead to pregnancy, although the frequency increases as one approaches peak minus 3 days. Since there is a ±48 hour variation between peak mucus and estimated time of ovulation, (Tables 1 and 2) it is still possible that sperm generally do not survive more than 72 hours, as some have alleged; 5-day intervals between intercourse and the peak day are seen fairly often. Hanson reports no difference in the numbers of sperm in midcycle mucus 1 and 48 hours after artificial insemination, utilizing a cervical cap.[30] Natural family planners bracket the fertile phase from the onset of "fertile type (E) mucus" until the fourth day past peak, or the third evening of the thermal shift (see below for methods).

Risk of chromosomal anomalies with Natural Family Planning

Concerns that non-optimally timed intercourse (at the beginning or end of the fertile phase) might cause adverse pregnancy outcomes similar to those found in animals after conceptions with aged sperm,[31] prompted a study of coital records and pregnancy outcomes among 868 NFP users. Conception was optimally timed if intercourse occurred within 48 hours of the estimated day of ovulation - peak mucus and/or day -1 or 0 of the basal temperature rise, (p. 9) otherwise non-optimally timed. Spontaneous abortions of optimally timed and non-optimally timed conceptions were similar: 9.1 vs. 10.9%. However, a subset of 171 women who had a previous spontaneous abortion and had non-optimally timed coitus with the index case had an increased risk (2.35) for another abortion with coitus either at the beginning or end of the fertile phase).[32]

Sex Preselection

Centrifugation, microelectrophoresis, and density gradient sedimentation have been used to separate X and Y sperm in animals.[33] Only density gradient sedimentation has produced a slight change in offspring sex ratios-60:40, hardly impressive. Glass cites Kleegman's finding that insemination just prior to or at the time of ovulation produced a preponderance of males (70 to 80 per cent), while insemination 2 days or more prior to ovulation produced a preponderance of females, as did insemination 2 to 8 hours after ovulation. Glass also cites Shettles, who supported Kleegman, and attempted to identify the Y and X sperm using phase contrast microscopy. Shettles believes that the smaller round headed Y sperm would reach the ovum faster than the larger, oval X, hence, coitus close to ovulation would favor the Y sperm as conditions for sperm ascent were optimal then. Since favorable conditions included maximal cervical mucus alkalinity, coital techniques, as well as alkaline precoital douches, were recommended to enhance the opportunities for achieving a male offspring. In the light of Settlage's work,[28] the value of any technique other than timing is dubious, but when couples followed Shettles' regime, 19 males were conceived by 22 couples, while 16 of 19 couples achieved a desired female. Cohen,[34] on the other hand, used maximum spinnbarkeit of the cervical mucus as his criterion for insemination with donor sperm, and found no difference in sex ratios of the offspring. The value of attempting to enrich the Y sperm with 2% serum albumin after separation is still accepted.[35] Ericson was able to report 76% males with his protocol, while clomiphene citrate induction plus sperm separation yielded 79% females for 146 women. The results cannot be due to enrichment of the X chromosomes, hence the mechanism is still unexplained.

Gray's meta-analysis of coital records of the World Health Organization Study of the Billings Ovulation Method, and of the studies of Guerrero, Harlap, Perez, France and Gray who attempted to identify the day of conception by selecting the coital act on the most fertile day, judged by thermal shift or calendar, found no scientifically valid relationship between the timing of coitus during the fertile phase and sex ratios of the offspring.[36] Unfortunately the studies lacked uniform definition of the day of maximum fertility, and failed to restrict themselves to cycles with only one coital act in the fertile phase. McSweeney's study met these requirements: a prospective study of 99 couples in Ondo State, Nigeria, reports a 90% success rate for male and female preselection among couples trained in the Billings Ovulation Method under the following conditions: To select a male offspring, couples avoid intercourse until the second day after peak. If pregnancy does not ensue, they are advised to use the day after peak. Of 81 couples who preselected for a male child, 96.3% were successful. To select a female child, intercourse should take place preferably two days before the peak. The success rate for female selection was 88.9% of 18 couples.[37]

HISTORY AND METHODOLOGY OF NATURAL FAMILY PLANNING*

Calendar Rhythm

In 1903, Fraenkel demonstrated that the life of the corpus luteum is 2 weeks. His findings were verified by Ogino in 1924, who described the normal luteal phase as 12 to 16 days long, and by Knaus in 1933, who reported that menstruation follows ovulation by approximately 2 weeks.[5] When an accurate menstrual history of the last 6 to 12 cycles is available the fertile and infertile phases of the cycle can be calculated. Hartman[38] calculated the fertile phase of the cycle by assuming a 12 to 16 day normal luteal phase, 72 hours for sperm survival, and 12 to 24 hours of ovum fertilizability. He calculated the estimated fertile period in a woman who had accurate records of her last 12 cycles by subtracting 18 days from the shortest cycle to determine the first day of the fertile phase, and by subtracting 11 days from the longest cycle to find the last day of the fertile phase. Perhaps because of variations of the normal woman's cycle, which are more marked when women are irregular,[39] calendar rhythm is generally credited with at least 20 per cent method failure. Roetzer has found that if one subtracts 20 days from the shortest cycle, rather than 18, the unplanned pregnancy rate is reduced; Roetzer uses the calculations in combination with cervical mucus, cervical palpation, and thermal shift.[40] The use of calendar rhythm as an isolated method is not advocated by natural family planners, but it is still widely practiced and still leads to many unplanned pregnancies, particularly among women who have an inadequate grasp of the necessary calculations. [41]

Basal Body Temperature

In his monumental work on the menstrual cycle, Vollman reports that the postovulatory rise in the basal body temperature (BBT) has been recognized at least since the beginning of this century. It is widely utilized in infertility studies to confirm that ovulation has occurred, and as a natural method of family planning. By 1936, Rubenstein had begun to correlate the nadir of the BBT curve with the preovulatory vaginal (Papanicolaou) smear, and in 1938, Palmer found that endometrial biopsies performed during the elevated temperature phase were uniformly secretory. Vollman correlated mid-cycle pain with the temperature shift in 1940.[42] There is still no agreement as to the best technique for the determination of the pre and postmenstrual phases by means of the thermal shift and, by implication, the timing of ovulation.[43] Vollman averages all the daily readings of the preceeding cycle and defines the shift as the day of the intercept between the mean and the actual temperature curve, and considers ovulation to have occurred if there are 3 consecutive higher than mean temperatures.[42] In the case of a "slow, step-wise rise," Roetzer cites Marshall as considering the fifth elevation of temperature from the foot of the rise as commencing the infertile phase. Buxton and Engel consider the first day of the rise as commencing the postovulatory infertile phase,[44] while Morris et al.[45] utilize the nadir of the curve as the time of ovulation. Probably the most widely used criterion for commencement of the postovulatory infertile phase is the "coverline." The coverline is a line drawn on a BBT graph 0.1° F above the last six low readings prior to the perceived rise. There must be three readings of 0.4° F above the coverline to assure that postovulatory infertile phase has begun,[46] but McCarthy and Rockette have documented that the "running low average for at least 3 consecutive days, followed by a rise of at least 0.3°F provides the best concurrent chart interpretation method."[47] Some groups take the highest of the last six low temperature readings. BBT users advise the use of a basal or digital thermometer, but some favor rectal or vaginal temperatures while most United States groups accept oral readings as satisfactory.

While there is consensus that the presence of the thermal shift indicates that ovulation has occurred, the precision of the thermal shift to pinpoint ovulation is less certain. The cyclic variations in the viscosity, sperm penetrability, and amount of cervical mucus, and its correlation with the basal body temperature were reported by Viergiver and Pommerenke in 1946.[48] Their charts, as well as those of Moghissi,[8] Billings et al.,[11] and Hilgers and Bailey[49] indicate that the thermal shift could occur as early as 3 days before or as late as 3 days after the LH peak. Renaud found that five of his ten subjects had an ovulatory BBT pattern on the day prior to follicular disappearance, four showed the change on the day of follicular disappearance, while one showed it the first day after disappearance.[15] Flynn and Lynch[12] and Morishita et al.[14] only utilized the biphasic BBT pattern to indicate that ovulation had

* See Appendix on page 26 for Summary of rules for NFP methods.

occurred, without trying to correlate the BBT shift with hormonal or mucus changes. Hilgers and Bailey studied 66 cycles of 24 women, correlating BBT, cervical mucus, serum LH, and progesterone. The BBT curves were analyzed according to four parameters for the shift: nadir, dip, first day of rise and cover line, and correlated with the other parameters. In 95% of their subjects, the thermal shift occurred over a 7-day range, ±3 days before, at, or after the estimated time of ovulation as determined by the "peak symptom," LH surge, and serum progesterone (>5 ng/ml), while the other 5 per cent of subjects varied over a period of 10 days. They conclude that none of the four criteria for BBT end points was precise enough to be a meaningful indicator of the "day of ovulation." They found two monophasic cycles in subjects with mid-luteal progesterone levels of 16 and 21 ng/ml, respectively, and 3 biphasic cycles (4.2%) without adequate rise of progesterone.[49]

Vollman, defining the thermal shift as the intercept between the average of the preovulatory readings with the rise in temperature on the BBT graph, analyzed 74 parous women who reported 1438 coital acts in 561 sterile and 43 conception cycles. In cycles with a single coitus, one pregnancy resulted from coitus on the 9th day prior to the shift, 38 conceptions began between 6 and 1 days before the shift, while four occurred 1 day after the shift. No later conceptions were found.[50] Kambic and Gray asked four experienced reviewers to determine the peak mucus day, the first rise of BBT, and the first and last fertile days of 66 pregnancy charts which were difficult to interpret. Most (94.4%) selected the same coital act as the putative conception act, while agreement on mucus peak = 70% and on first day of BBT rise = 38.5%.[51]

Sympto-thermal Methods

Calendar-thermal. In the 1950s, investigators began to combine the calendar calculation with the postovulatory thermal shift. All early studies except Marshall's are retrospective and shown in Table 4 on page 11.

Sympto-thermal Methods. Most women experience breast sensitivity or tenderness *Mittelschmerz*, (interpreted as backache, abdominal pain with referral to either the anterior or posterior compartments of the thigh), as well as cervical mucorrhea (peak symptom) and some labial edema tending to close the posterior fourchette at the time of ovulation. Canadian thermal method programs have considered the thermal shift to be determinative, while the symptoms of ovulation were considered ancillary for the determination of pre- and postovulatory infertility.[61] Roetzer, using his own data and those of Rauscher, has utilized the onset of mucorrhea as the marker for the beginning of the fertile phase and uses the 4th day after the peak symptom and the 3rd day of thermal shift, whichever is later; to delineate the onset of postovulatory infertility.[62] [See Appendix A for summary of rules.] Self observation of the cervix via palpation and, sometimes, inspection by speculum was introduced by Keefe in 1962.[63] In his study of 22 women, he noted that the cervix opens during the ovulatory (estrogenic) phase. The os is pinpoint at the onset of ovulatory phase, dilates in response to estrogen rise, and closes after ovulation. In response to rising estrogen, the cervix also becomes softer in consistency, pours clear, lubricative, elastic mucus, rises higher in the vaginal canal, and is apt to be harder to reach with the finger. Keefe found that the dilation of the os and the finding of mucus were the most consistent, while the other two signs were found by half the women. Most women were able to detect the postovulatory cartilage-like consistency of the cervix, but apparently the pre-ovulatory softness was not so easily apparent. Keefe taught that the mucus must be obtained at the cervix because it appears earlier, while Kippley[64] writes that it dries before reaching the vulva. (See section: Vagina, above.) When cervical os examination is used in natural family planning, it is used in conjunction with the "major" parameters, mucus and thermal shift([64], [65], [66], [67], [68]). Some of the groups also retain the calendar calculation previously described. Rice et al. conducted a prospective calendar thermal study which included some symptothermal users and some use of barrier methods. (See Table 5 on page 12)

Cervical Mucus: The Billings Ovulation Method

Billings pioneered the use of cervical mucus as a single parameter for the prediction of ovulation and its application to natural family planning.[88] Women are taught to observe their mucus patterns at the vulva, relying primarily on the sensation of wetness and lubrication obtained via ordinary sensation, augmented if necessary by the use of the Kegel exercise, palpation with the finger, a "wipe-through" with toilet paper, or a combination of the above. Visual observation of the mucus evaluates opacity/ transparency, color, and mucus elasticity. It is stretched to determine spinnbarkeit.

According to Brown,[22] whenever total estrogens exceed the threshold of 15 mg/100ml/24 hr., the cervical mucus is sufficiently liquefied to leave the cervix

and appear at the vulva. If a cycle is ovulatory, the mucus will become increasingly lubricative, elastic, and clear until it reaches its "peak;" the changing behavior of the mucus is called the mucus "build up." "Peak" is defined as the *last* day of lubricative mucus, not the day of the maximum quantity or maximum stretch (elasticity). The close temporal correlation of "peak" with LH surge has been previously discussed. The Billings method presumes that once "fertile type" mucus - Odeblad's L, S, and P types - has begun, sperm can be maintained in a viable state in the cervical crypts and other uterine sites until ovulation. Experience has shown that in order to avoid pregnancy, couples must abstain from the onset of any mucus after the early dry days until 72 hours beyond "peak."[89] Women are taught to look for the pattern of the developing mucus buildup pattern until peak, they are also taught to distinguish between mucus, which has cohesion ("body") and elasticity, and other vaginal discharges, i.e., seminal discharge and the fluid of sexual arousal, neither of which cohere, and vaginal detritus, which is sticky, pasty, but never stretches beyond 0.5 cm.[90] When the ovulation method is used to avoid pregnancy, users are asked to abstain during any preovulatory mucus day, which is presumed to indicate follicular ripening until the fourth evening past the occurrence of the mucus day or days, and from the beginning of the normal build up until the 4th day past peak (the "peak rule"). They are asked to abstain during menstruation, which may mask the onset of mucus in a woman with a short proliferative phase, and on any day of out-of-phase bleeding (plus 3 days) which may easily be ovulatory. After the learning phase, many women can distinguish menses from onset of mucus, and also know their baseline discharge as distinct from cervical mucus. The "early dry days," post menstrual days prior to the onset of mucus, are infertile. Couples are asked to restrict coitus to the evening of alternate dry days to prevent confusion of seminal discharge with mucus, and to allow ample time for recognition of mucus. After ovulation, progesterone abruptly suppresses the peak mucus, the mucus pattern continues with sticky mucus for a day or two, and then returns to dryness. (Fig. 8 on page 13)

In the WHO field trial of the ovulation method, 90% of women were able to distinguish their mucus

Table 4: Early Retrospective BBT and Calendar Thermal Studies
(adapted from Table 6, H. Klaus, Natural Family Planning: A Review, 1982)

Author/year/coutry	Method	No. of users	Exposure (mos./cycles)	Method-related rate	Teaching-rel.preg.rate	Informed ch. preg.rate	Unresolved pregnancy
Döring [52] 1967 Germany	Strict BBT Calendar and BBT	307 689	11,352 48,214	0.0 1.5	O.3PR* 0.3PR*	0.52* 0.28	
Rötzer [53] 1968 Austria	Supplemented S-T	163	3,206	0.0	0	0.68	
Bartzen [54] 1967 USA	Calendar-Thermal	296	4,824	1.5 PR	8.2PR*	10.8	
Rendu and Rendu [55] 1966 France	Calendar-Thermal	400	18,656	0	1.03*	2.2*	
Guy and Guy [56] 1973 Mauritius 1965	BBT	14,271 1,491	16,735	0	Overall, 8.03 1.4*	4.2*	2.4*
Traissac et al. [57] 1963 France	Strict BBT	250	4,556	?	4.47PR*	9.2	
Vincent et al. [58] 1963 France	Calendar-Thermal strict BBT	782	10,657* 17,496*	10.2 PR* 0.60*		52.6* 4.4*	
Dunn [59] 1975 New Zealand	Calendar-OM ST combin, NaCl hormone assay	345	total 23,244	2.7 PR		2.0	
Marshall [60] 1968 UK Prospective	Strict BBT Calendar-Thermal	321 255	4,749 3,545	1.2 PR 5.0		4.2 13.3	1.2 1.0

* Analysis according to new Los Angeles terms adopted by compiler from published data. P.R. = Pearl Rate; Rel.= related; Ch = Choice.

Table 5: Major Prospective Use Effectiveness Studies until 1982

(adapted from Table 6, H. Klaus, Natural Family Planning: A Review, 1982)

Author/year/coutry	Method	Number of users	Exposure (Mos./Cycles)	Method related rate	Teaching-related preg. rate	Informed choice preg. rate	Unrespived preg.	Cont. rate
Rice et al.[69] 1981 Canada, Mauritius, USA, Phillippines, Colombia	Calendar-Thermal; sometimes S-T; Calendar-Thermal w/barrier contra.	6,323 369 723 299	13,658 6,556 14,416 6,157	NA NA 0.75 PR 1.36 PR		Limitrs.Spacers 4.1PR 8.1LT 14.8* 28.15LT NFP only 5.5PR 13.7LT NFP mix 8.9PR 15.7LT		Lim. 80% Spac. 50%
Ball [70] 1976 Australia	OM	119	1,578*	2.9+	5.9	6.7	-	67%
Dolack [71] 1978 USA	OM	329	3,354	1.1 PRr	-	6.4	2.1	92%
Johnston et al. [72, 73] 1979 and 1981 Australia	OM; OM mix; OM Calendar; S-T Calendar S-T; S-T mix		6,499 1,017 7,793 1,573	11.26 PR 2.62 2.62	NA 12.2 PR & LT	32.13 PR 7.57 13.6* 6.2	2.62 - -	53.3% 65.7% 65.7%
Wade et. al.[74, 75] 1979 and 1981	OM S-T	191 239	1,269 1,668	1% LT 0 LT	-	13.6* 6.2	- -	26.3% 51.7%
Medina et al. [76] 1980 Colombia	OM S-T	130 111	1,064 969	only total ---------- preg. rate comp. ----------		22.2%---------- 19.1%----------		28% 23%
Klaus et. al.[77] 1979 USA	OM; OM+S-T OM-barriers OM+ST+barriers	1,090	12,282 3,903 1,452	PR LT 1.17 1.3 0.22 0.7 0.22	- - -	PR LT 19.25 22.7 6.76 6.61 17.3	-	56% 48%
Haliburn [78] 1980 South India	OM	817	9800	0 PR	-	0.37%	-	99.52%
WHO [79] 1981, Ireland, Philippines, India, Salvador, N. Zealand	OM	725	7514	2.8	3.9	15.4 LT	0.5	65%
AIDER [80] India, 1981	OM MMM	96,641	1,010,489	0.11 PR	-	1.69%	-	92%
Marshall [81] 1976 UK	BBT + mucus	64	1,195	PR 13 (?)* Total rate 22%	-	7%(?)	2	38%
Mascarenhas et. al. [82] 1979 India	OM	3,530	39,967	0.06%	-	6.6 LT	-	86.3%
Klaus and Fagan [83] 1982 USA	OM	97	782	0	3	7.7	1.5	92%
Kambic [84] 1981 USA	S-T	235	1,973*	1.3% LT	NA	16.7% LT	-	52.4%
Dorairaj [85] 1981 India	MMM OM	1,977 1.799	15,052 18,156	0.16 PR 0.13	0.08 0.00	0.08 2.37	- -	99.4%
Hilgers et al. [86, 87] 1980 USA	OM Creigh. Mod.	-	-	0.4	0.7	Unable to cite: terminology differs		85.5%

* Analysis according to new Los Angeles terms adopted by compiler from published data.

\+ O.M. rules were changed to include *all* changing mucus after menses as the result of this study.

pattern during the first cycle. Most women are proficient by the third cycle unless they are discontinuing anovulant medication or lactating. After three to six cycles have been experienced, the onset of the fertile phase and the peak symptom are easily recognized by most clients. The use of the color-coded stamps or symbols has facilitated discerning fertility patterns and overcome the barrier of illiteracy. Figure 8 shows the hormonal pattern of an ovulatory cycle and its recordings by means of the Billings system of colored stamps:

Red = bleeding
Plain Green = dryness
White stamp with baby = mucus
X = "peak" mucus (last day with fertile signs).
Yellow stamp with baby = sticky mucus during 3 days of continuing fertility after peak (ovum may still be viable).
Green stamp with baby = 3 days of continuing fertility after peak when no mucus is present.
Red stippled = spotting

If a woman does not ovulate, her cycle does not show a build up and peak pattern, but only isolated mucus days which reflect a slightly elevated estrogen level (Fig. 9). Users of natural family planning for pregnancy avoidance are cautioned to avoid all genital contact during the fertile phase, as the first portion of the seminal ejaculate is known to have the highest sperm concentration.[91] This statement has been validated by many conceptions begun without penetration. [See Appendix on page 26 for rules of the Billings method.]

Puberty

Anovulation is frequent during the first four years of gynecological age (years from menarche), hence, some question whether a method for the recognition of ovulation by self-detection of cervical mucus patterns is useful in teenagers. Our detailed records of 235 teenage women who learned to monitor their fertility patterns using the Billings Ovulation Method (BOM) refute the pessimistic premise. The subjects were 15-17 years of age with gynecologic ages of < 1 to 7 years. Cycles were analyzed by the length of the mucus and luteal phases and recorded peak symptom. Ovulatory cycles were grouped by the length of the luteal phase, short (4-8 days) and average (8-18 days), and plotted against gynecologic age. The frequency of anovulatory cycles was comparable to Vollman's age-stratified monophasic cycle groups. At gynecologic

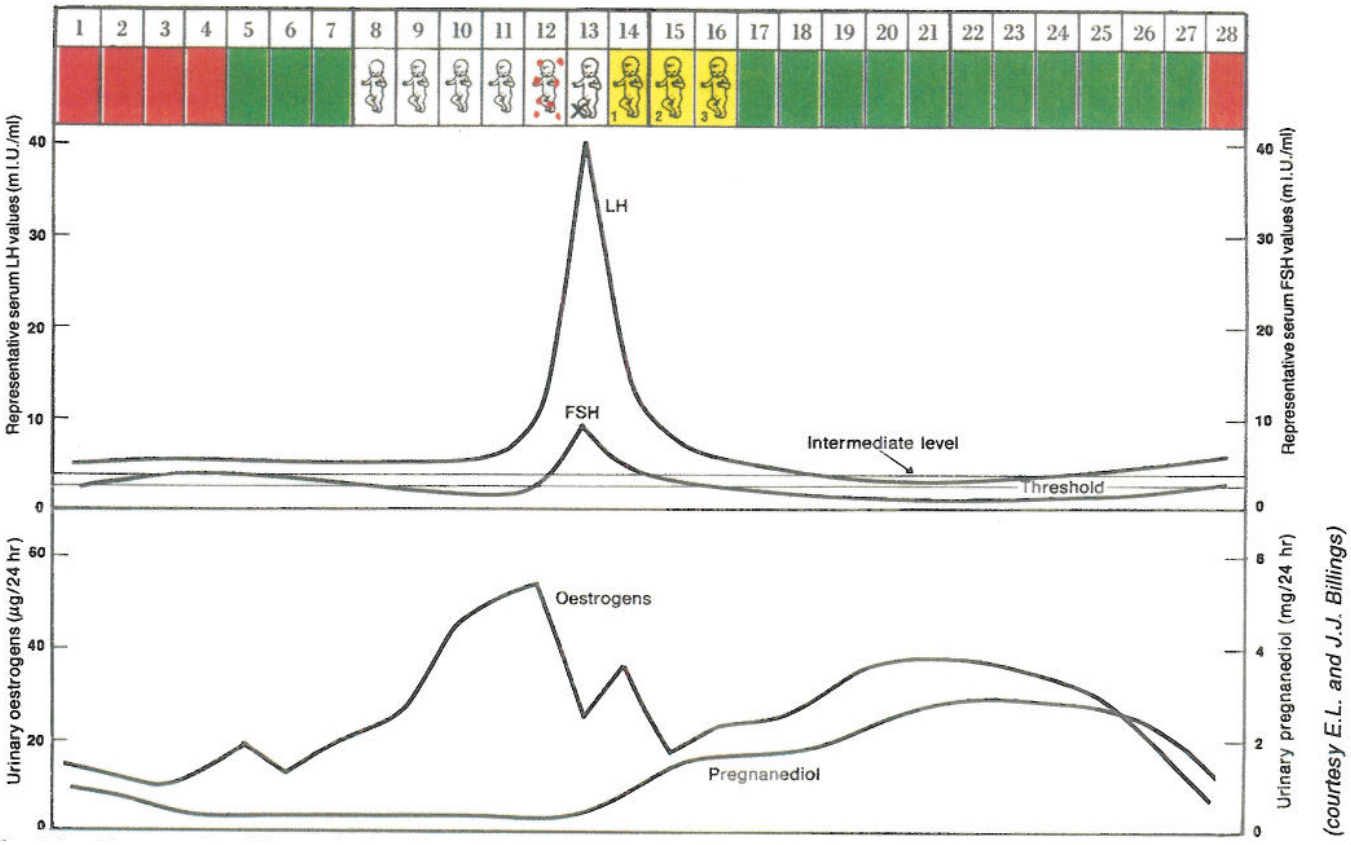


Fig. 8: Hormonal levels and corresponding stamp chart during a normal menstrual cycle.

age of 1 year, 49% of cycles were ovulatory; at 2 years, 60%; at 3 years, 72%; at 4 years, 61%; at 5 years, 86%; and at 6 years, 71%. The study proved that teenage women can distinguish patterns of ovulation and anovulation by self-detection of cervical mucus. When the cycles were anovulatory, the number of days which follow the last day of mucus seldom equalled those of a normal luteal phase, being either shorter or longer.[92,93] During stress, anovulatory cycles are frequently encountered.[42]

Lactation

Full lactation suppresses FSH and LH initially because of the high prolactin level, but amenorrhea may very well persist even when prolactin drops because the hypothalamo-pituitary ovulatory cascade is disrupted. When using the ovulation method or sympto-thermal methods, the woman is instructed to observe for the return of any signs of mucus, either by sensation or visual observation, and to presume that fertility is returning when signs are encountered. It is not uncommon to encounter a thin gray non-lubricative discharge during full lactation because of (physiological) atrophic vaginitis. This is different from mucus which has body and lubrication, or at least a rubbery consistency and elasticity. Once signs of fertility are encountered, the woman initiates the rules of the method.

The lactational amenorrhea method (LAM) is now being introduced into a number of countries by the World Health Organization and allied agencies. The Bellagio Consensus found that if the mother is still amenorrheic when her baby is six months old, and she is fully nursing, i.e., giving the baby only the breast, no top feeds, no fluids, except for an occasional taste of food, she had only a 2% risk of pregnancy. At such time, according to the present algorithm, she is invited to consider a transitional method.[94] Multi-country effectiveness studies are now in progress. Many women do not fully breastfeed for six months, while other fully lactating women return to menstruation and ovulation at 150-180 days postpartum. The "short amenorrhea" group has lower biologically active (BIO-PRL) prolactin than immunoreactive (IR-PRL) levels, while the "long amenorrhea" groups exhibit higher BIO-PRL levels.[68] Unless one is able to screen for BIO-PRL/IR-PRL ratios, it is highly advisable to invite women to begin to observe for signs of mucus as soon as the lochia stop. In that way, they will not be sur-

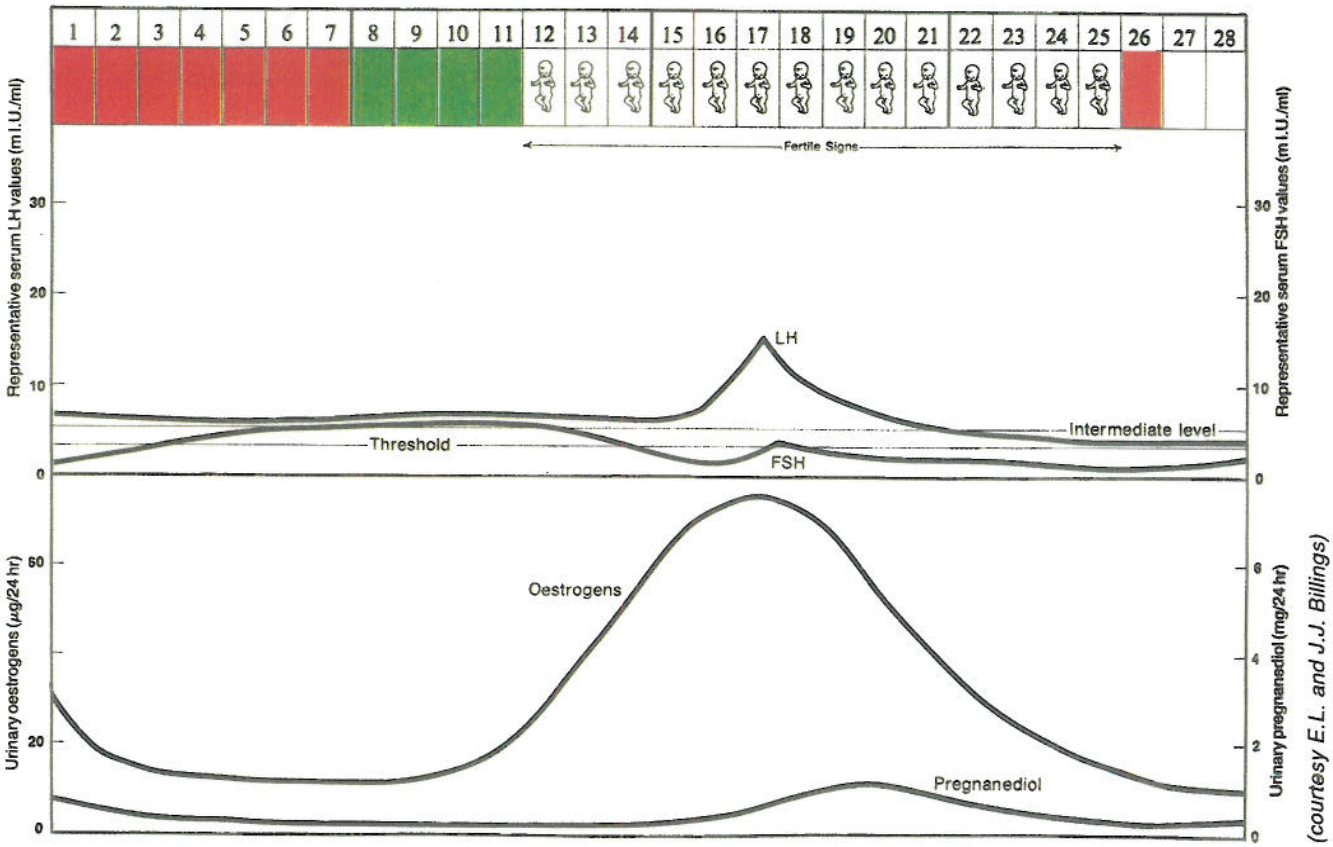


Fig. 9: Hormonal patterns of an anovulatory cycle

prised by the return to fertility. There are anecdotal reports of return to ovulation and menstruation despite full nursing as early as 12 weeks postpartum.

Vigil et al. have performed postpartum cervical mucus sperm penetration assays according to WHO criteria. Fully breastfeeding and amenorrheic women were studied at 30, 60, 90, 120, 150, and 180 days postpartum, and compared with mucus samples from normally cycling women. Thirty-nine percent (39%) of the postpartum and all of the periovulatory mucus samples of the controls allowed sperm migration. Migration was noted at all the time intervals studied, and was highest when mucus scored > 8. However, samples with much lower scores, 2-7, also showed penetration.[96] In non-lactational states, Odeblad found that both G- and G+ mucus are barrier to sperm entry.

Premenopause

The 4 or 5 years preceding menopause are characterized by erratic ovulation, varying length of cycles, and diminished fertility. Vollman[42] found that postmenstrual phases shorten from age 20 onwards, while luteal phase lengths remain essentially stable during and after maturity. Monophasic cycles comprise 10 per cent of cycles at age 35 and increase to 34 per cent by age 40 to 45.

Since decisions about abstinence are not made in retrospect, the premenopausal couple who wishes to avoid pregnancy must rely on the prospective signs of the cervical mucus and/or cervical os. Calendar calculations generally become misleading at a time of unpredictable ovulation. Unless the cervix can produce L & S mucus, many premenopausal ovulations are not fertile ovulations, since the conditions for sperm entry are not favorable. However, NFP users are unlikely to wish to test the system, hence observe the method rules carefully. E. L. Billings followed 98 women, aged 38 to 45 years for 4 years, with mucus observation, BBT, urinary estrogens, and pregnanediol. She compared the types of mucus observed with the hormonal pattern. Many cycles were ovulatory with an elevated pregnanediol and biphasic BBT curve, yet the mucus was described as "dry," "crusty," "different," "insignificant," never slippery, stretchy, cloudy, clear, or lubricative. Some of these couples had had intercourse just before or at the time of ovulation, but did not conceive. Eight of the women in the over-45 group had estrogens of 100-214 µg per 24 hours yet reported "insignificant" mucus. Forty-eight women experi-

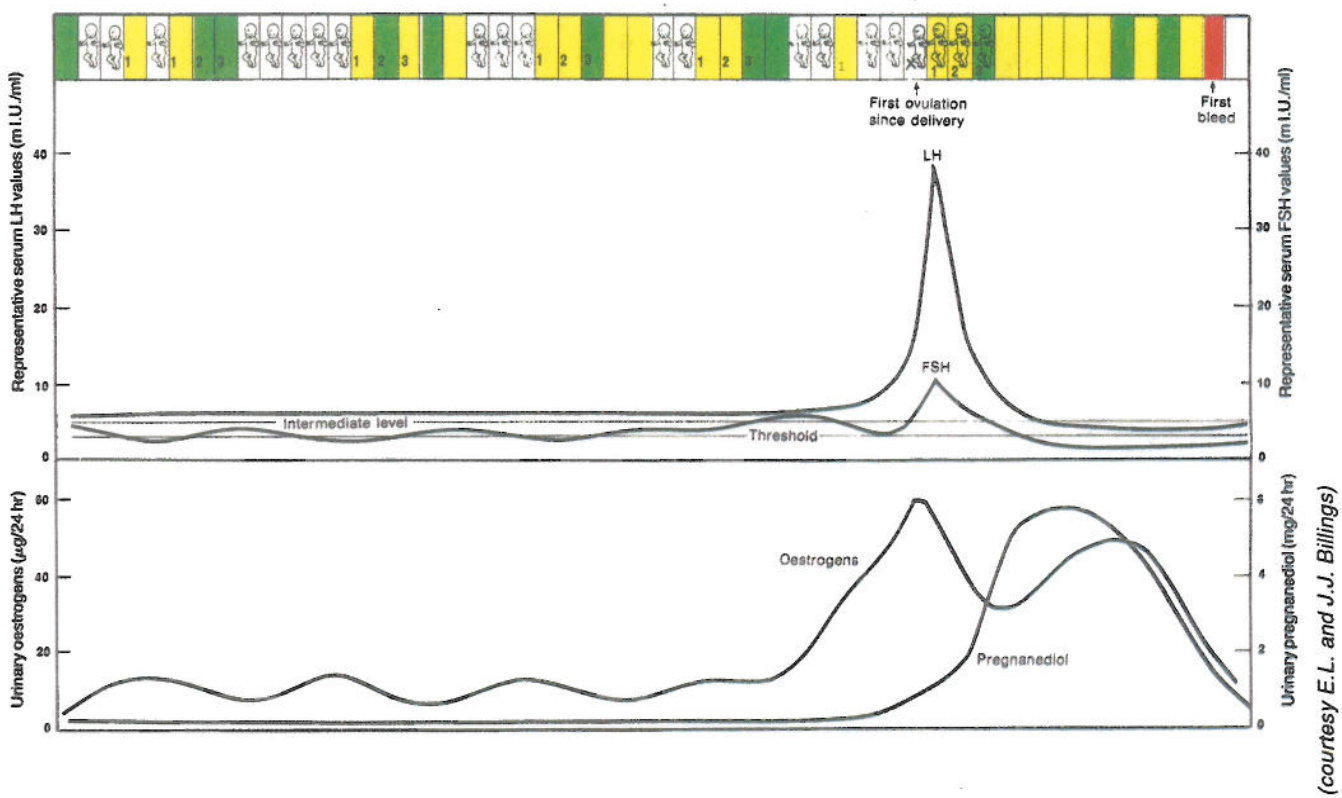


Fig. 10: Hormonal patterns during breast-feeding

enced a return of a fertile pattern after some months of insignificant mucus. When that occurred, the luteal phase was 2 weeks long. Ninety-six of the 98 women were followed for 4 years. One discontinued because of hysterectomy for menometrorrhagia, another recognized her fertile pattern but opted for coitus and conceived.[97]

Billings concludes that the development of satisfactory mucus at this age cannot be related in linear fashion to the total estrogen level. Estradiol is significantly lower at this age, while estriol rises, hence the high total estrogen level may not elicit a corresponding fertile-type mucus, which Brown has correlated with 17 ß-estradiol.[89] The changed appearance of the mucus may also reflect the diminished number of L and S crypts in the cervix. (See **Aging of the Cervix**).

While hot flushes often accompany dry days (with low estrogen levels) the flush reflects an LH surge induced by a GnRH surge. If signs of possible fertility (mucus or cervical softening and dilation) have been noted, a hot flush should never be thought to indicate infertility. Supplementary, unpublished data of Klaus et al. show results similar to that of E. L. Billings (Table 6 on page 17). It is evident that fertility is much lower in older age groups; but most of the users are "limiters" at this time and far less inclined to take risks by breaking rules, so that more than one factor is operant.

During premenopause, the same rules for determination of infertility/fertility apply as in other anovulatory phases. The basic infertile pattern is sought. As long as there is no evidence of mucus secretion (or cervical change), the rule for early dry days is followed. If a base-line sticky, pasty, unchanging mucus discharge appears, abstinence is observed for 2 weeks to observe the new pattern adequately; the couple are then free to apply the early-day rule as if for dry days. Any change in the mucus toward fertile type, such as increasing wetness, lubrication, stretchiness or transparency, calls for abstinence until the fourth evening past the last sign. Any bleeding or spotting, with or without mucus must be presumed to be possibly fertile and calls for abstinence until the fourth evening after the last sign.

Since ovulation is erratic, waiting until there has been a thermal shift would demand complete abstinence during monophasic cycles. Following Roetzer's teaching previously cited, most sympto-thermal teachers recommend reliance on the cervix and cervical mucus for premenopause.

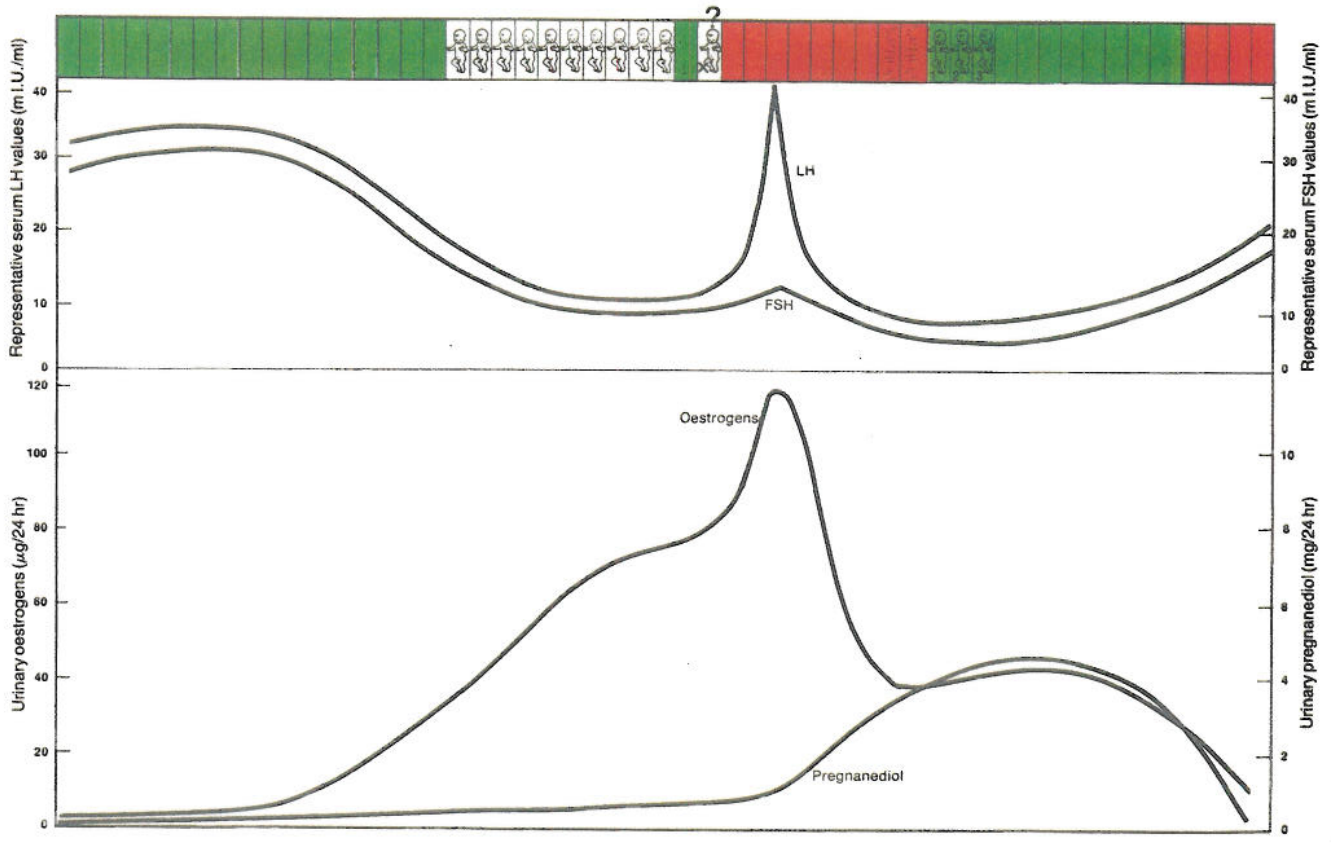


Fig. 11: Hormonal patterns during the course of a cycle in a perimenopausal woman.

Discontinuation of Ovulation Suppression

The return to fertility after discontinuation of ovulation suppressants varies from immediate resumption of previous patterns to post-pill amenorrhea. If the woman is going to ovulate, she will find a mucus build up followed by biphasic temperatures. The cervical eversion which is found in at least 25 percent of women who have used the birth control pill for over 3 months[98] weeps copious amounts of fertile-type mucus once the woman stops ingesting progestins. It is not unusual to find 14 days of slippery, stretchy, clear mucus in the first off-pill cycle. Experience has shown that if the number of mucus days do not decrease considerably by the third cycle, cryosurgery or silver nitrate treatment after cytologic and colposcopic studies have shown no other pathology, is appropriate and curative. Care must be taken not to confuse the normal eversion of the preovulatory cervix with persistent effect of the "pill." It is also important to freeze only the glandular epithelium on the portio vaginalis, and not destroy the normal endocervix. Excess freezing or hot cautery can destroy the mucus-producing crypts, as can a high conization. While a cervical eversion is weeping, a woman may not be able to distinguish her peak symptom, particularly if she has had no prior experience. Monitoring BBT at least initially may help build confidence.

Cervicitis and Vaginitis

A woman who knows her fertility patterns will detect an abnormality quickly and seek treatment. Chronic baseline discharge is readily distinguished from the buildup pattern. Local medication may mask mucus (as do contraceptive foams and gels). If the pattern cannot be perceived, and the couple do not wish to risk a pregnancy, they must abstain until their pattern becomes recognizable[89] or until they have recorded at least four elevated basal temperatures.

With systemic or local antibiotic treatment, monilial vaginitis is common, and of course may obscure the mucus pattern. Abstinence must be advised until the pattern clears, if pregnancy avoidance is desired. Penicillin and guafenisin are associated with an increase in L and S mucus. Antihistamines decrease and thicken cervical mucus.[99] Cervicitis produces an "inflammatory mucus" similar in structure to G mucus.[24]

Ovulation Suppression by Stress and Pharmaceuticals

The role of physical and emotional stress in suppressing ovulation via alteration in the hypothalamo-pituitary axis is well known and well documented. Sudden weight loss, environmental stress and/or change, have led to amenorrhea.[100] When stress suppresses ovulation, a pattern of intermittent mucus without a peak is seen. Such a cycle is, of course, monophasic, and shows no increase in progesterone. Often the emotionally or physically stressful events are easily correlated with the mucus patterns, and resolution of conflict is then followed by (delayed) ovulation.[89] Athletic amenorrhea is associated with normal body composition, low baseline concentrations of LH and normal concentrations of FSH, normal to hyperresponsiveness of LH and FSH to GnRH testing, and normal and possibly increased frequency of LH pulsations.[101] McArthur et al. believe that an alteration in the hypothalamic control of gonadotropin release, independent of body composition, is operant in the development of "athletic amenorrhea." While mucus observations were not made by their subjects, vaginal cytohormonal studies indicated moderate vaginal atrophy. Taylor et al.[102] have correlated the highest karyopyknotic index with the peak mucus symptom and found close correlations.

The use of psychotropic drugs, particularly the phenothiazines, is associated with amenorrhea and, at times, with inappropriate lactation, presumably as a result of prolactin increase. In such women, the normal ovulatory mucus pattern is disturbed and can signal the disturbed hormonal picture. There are anecdotal reports that smoking THC (tetrahydro-cannabinol) - "pot" (marijuana) - suppresses ovulation; and

Table 6: Pregnancy in Premenopause

Age	N of Subjects	N of Cycles	N of Planned Pregnancies	Unplanned Pregnancy, (Pearl Rate)	
				Method Related	Informed Choice
40 - 44	99	3757	3	0.32	1.6
45+	38	1123	1	0	0

(E. L. Billings)

when this occurs it is reflected in the mucus patterns. No hormonal correlations have been published to date. While ovulatory disturbances are seen in hard drug users, they are difficult to define due to erratic use, life style, and diets. (They are known to become pregnant.) Any systemic illness which interferes with ovulation, i.e., hypo- or hyperthyroidism, will be reflected in the mucus and thermal patterns.

Technological Approaches to Ovulation Detection

Various monitoring devices have been used to correlate physiological fertility signs with hormonal parameters. Some devices are teaching aids or are used to clarify a difficult mucus pattern while others are marketed as "less subjective" than self detection of mucus. Still other devices measure vaginal fluid volume, or program calendar rhythm data and thermal shifts into computers. Numerous devices, particularly dipsticks for the detection of LH have been marketed. Dipsticks for LH surge can identify the impending LH surge 72 hours in advance, thus assisting couples who seek to achieve pregnancy to identify their most fertile days. LH monitors cannot be used for pregnancy avoidance, as most women have more than 2 days of mucus before peak, and sperm can remain viable in mucus for more than 3 days.

A. Flynn believes that technology might assist clients who find self-observation and careful recording either too difficult or too demanding, when a long learning phase is impractical because of discharges, or after treatment for cervical pathology, in erratic sleep patterns or other stresses - travel, etc., or simply if technology is more appealing. Two types of devices are available: physical monitors based on calendar BBT and mucus methods and dipsticks or other absorbent materials based on urinary metabolites of the sex steroid hormones LH, estradiol, and pregnanediol. All devices must be technically stable and reliable in order to detect the fertile phase in a high percentage of cycles. They should be easy to use, rapid, and not too expensive. Flynn tested the *Baby Comp, Cyclotest-D,* the *Bioself 110,* the *Cue Fertility Monitor,* the *PG/53 Fertility Tester,* and *Rovumeter Vaginal Aspirator*. Correlations of the monitors with radioimmunoassay studies of estrogen and progesterone was far lower than with self-detection of mucus and basal body temperature. The fertile phase was correctly identified in 66.7-93.3% of cycles. Several computers have been produced to compare basal body temperature reading, cycle information, and mucus observations. These offer a different sort of record of the observations and purport to relieve the user of the necessity of performing calculations. Various urinary test kits for estrogen and pregnanediol have been marketed. Most devices attempt to identify the beginning and end of the fertile phase, among them home monitors which detect the estrogen rise which marks the beginning of fertility and those which detect the rise of progesterone at the end of fertility.[103] WHO has supported field testing of several monitors, J. Brown's assay is among the most widely tested. The Brown Ovarian monitor utilizes a micrococcus enzyme immunoassay to measure the levels of estradiol and progesterone metabolites in the urine (estrone glucuronide [E_1G] and pregnanediol glucuronide [PdG]). The assay has been validated by comparison with radio-immunoassays.[104] In one WHO test site, the first fertile day was identified by the monitor in 88% of the cycles, while the mucus sign identified the first fertile day in 99.2%. The monitor anticipates the initiation of the first fertile day in 32% of the cycles compared with the Billings Ovulation Method, agrees in 25% of the cycles, and lags one day behind in 31% of cycles. The E_1G peak, peak day, and the LH peak agree closely. The LH peak also correlated very closely with follicular rupture as diagnosed by vaginal ultrasound. Using Brown's earlier criteria of PdG cutoff at 6.3 µmol/24°, the beginning of the infertile phase was reached before infertility had actually begun. Brown has since raised the PdG cutoff to 9 µmol/24°. In this study, the monitor delays the last fertile days in 19% of the cycles and anticipates it in 55% of the cycles. The average number of fertile days obtained: [105]

NFP Method	Ave. No. Fertile Days
Ovarian Monitor	8.9
Ovulation Method	10.4
Sympto-thermal	11.8
Bioself-110	15.0

Other devices were far less reliable. Since it is the mucus and not the hormone that serves as the gatekeeper for the sperm, it is never prudent to ignore the mucus sign.

Effectiveness of Natural Family Planning

Unlike contraception, natural family planning can be used either to achieve or to avoid pregnancy. Historically demographers have only concerned themselves with pregnancy avoidance. Most of the natural family planning studies report only effectiveness for avoiding pregnancy, while in fact, the methods can be used to achieve pregnancy as well. The

Table: 7 NATURAL FAMILY PLANNING (NFP) USE EFFECTIVENESS 1986-1994

Current NFP Effectiveness Studies Ranked by Pregnancy and Continuation Rates. Life Table Rates are Cumulative Net (unplanned) Pregnancies at One Year or 13 Cycles. Method: OM-Ovulation Method; MMM-Modified Mucus Method; ST-Sympto Thermal Method. Continuation Rate is the percent of acceptors who are still using NFP for pregnancy avoidance at one year, irrespective of their reason for discontinuation.

			One Year (Total) Unplanned Pregnancy Rate		
Country	**Year**	**Method**	**Life Table**	**Pearl Rate**	**Continuation Rate %**
Indonesia[107]	1990	OM	2.5		89.6
Liberia[108]	1993	ST/OM	4.3		78.8
Nepal[109]	1986	MMM	7.3		45.0
Zambia[108]	1993	ST/OM	8.9		71.2
Indonesia[107]	1990	MMM	10.3		81.2
Kenya[110]	1988	OM	10.5		46.0
Korea[110]	1988	OM	13.4		57.0
Bangladesh[110]	1988	OM	14.9		72.0
India[111]	1991	MMM		2.0	N.A.
Germany[112]	1992	ST		2.3	92.9
UK[113]	1991	ST		2.7	N.A.
Italy[114]	1988	ST		3.6	100.0
China[115]	1994	OM	7.0		80.0
Europe*[116]	1993	ST		2.5	48.0 * 9 countries, 14 sites.
Liberia[117]	1994	OM/ST	1.5		93.7
Liberia[117]	1994	MMM	6.6		66.0
India**[118]	1994	OM	11.6		76.0 ** 5 states.
U.S.[119]	1994	OM-Creigh.Mod.	12.8		78.0

(Adapted from Kambic, R.T.[120] with permission.)

early studies reported effectiveness as the Pearl Formula (the number of pregnancies per 100 women/ years). The life table was introduced in the 1970's to give a more accurate picture, not only of effectiveness but of continuation. (Tables 4 and 5 om pages 11 and 12)

In 1987, Trussell and Kost[106] pointed out that perfect use of the methods, when a method is used correctly and consistently, must be separated from imperfect use - rules not followed correctly or consistently - in order to distinguish between the limitations of the method and user factors. They applied this criterion to all methods, voluntary and involuntary. Studies reported to date still use Pearl Rate or life table, including those from the last decade which are detailed in Table 7.

Table 7 shows total use effectiveness, combining perfect and imperfect use, and continuation rates. Nearly all prospective NFP studies found less than 2% method-related pregnancies, while World Health Organization reported 2.8% for the Ovulation Method (Table 5 on page 12). The high continuation rates of modern natural family planning users balance the initial cost of instruction so that ultimately the method is more economical than any technological method.[121]

Achieving Pregnancy

Since the cervical mucus buildup pattern and the softening and dilatation of the cervical os indicate approaching ovulation (see above **"Sympto-thermal Methods"** and **"Cervical Mucus: The Billings Ovulation Method"**), these two prospective parameters are of great value to couples who desire conception. It is the general practice of natural family planning teachers to instruct women in the recognition and recording of their fertility sign(s) and to suggest some months of merely concentrating coitus at the time of maximum fertility. Referrals for further infertility studies depend on the duration of prior infertility, and the couple's age and history. In the United States, 90 per cent of physician referrals to NFP centers are for infertility,[83] while overall, 10 per cent of clients in NFP centers refer themselves for infertility.

Vollman[42] found that the probability of conception with isolated coitus is 0.2 two days prior to the thermal shift, 0.16 one day before the shift, and 0.2 on the day of the shift, while Barrett and Marshall[122] found that the probability of conception rose to 0.12 five days prior to the thermal shift, reached a peak of 0.3 on the day before the thermal shift, dropped to 0.13 on the day of the shift, and was 0.07 one day post-shift. Clearly the definition of the thermal shift is pivotal to its utility.[49] Brown reports 0.7 when coitus occurs on peak day.[104] Renaud correlates echographic disappearance of the follicle with the cervix, mucus, and BBT, as discussed in under "Sympto-thermal Methods" and "Cervical Mucus: The Billings Ovulation Method." It is clear that maximum fertility is at the time of the peak mucus symptom, while waiting for a thermal shift may mean the loss of optimal time for conception.

Barrett and Marshall have shown that fecundability rises with increased coital frequency, ranging from 14 per cent with coitus once a week to 68 per cent with daily coitus.[122] In the absence of organic barriers to fertility, pregnancy was achieved by 75% of clients reported by Hilgers[123], while 74 per cent of Klaus and Fagan's clients achieved desired pregnancies in an average of 2.76 cycles.[83] In a later report, Hilgers, et al. found that 76% of clients achieved pregnancy in their first cycle when they focused on the fertile phase, 90% by the third cycle, while a total 98% succeeded by their sixth cycle.[124] Prospective recognition of fertility patterns should constitute the first phase of any infertility study, before any invasive or costly tests are performed. While infertility specialists are aware of cervical mucus almost none instruct their clients to learn to recognize it, preferring to use BBT, blood hormone levels, and endometrial biopsies. Many of these procedures could be avoided if couples were taught to monitor their fertility and concentrate coitus on the fertile phase for a year prior to embarking on further studies.

Achieving Couple Autonomy

Mastery of natural family planning involves not only identification of the fertile phase, but integrating that knowledge into the couple's sexual decision making and behaviors. Once mastery of both aspects is achieved, the couple is able to exercise procreative choice for the rest of their reproductive life. Autonomy is achieved through accurate factual learning, as evidenced by adequate feedback, verbalized satisfaction of the couple, and by their continued adherence to the method (see continuation rates, Table 7 on page 19).

Confidence in the Method. Most researchers[80, 83, 110] found that on average, couples reach autonomy by the third cycle. Klaus and Fagan found that couples who had previously used contraceptives were more likely to make imperfect use of the method in their first or second cycles, compared to those who had used either no method or another natural method previously. Not surprisingly, Kambic and Martin found that autonomous couples have a 96.7% continuation rate at 12 months, and an unplanned pregnancy rate of 1.7%, while non-autonomous couples had a continuation rate of 34.3% and 24.8% unplanned pregnancies at 12 months.[125] Even a method with lower perfect use rate, which is used consistently will serve couples more effectively than a method which is theoretically effective but not used, as continuation is the final indicator of the utility of any family planning method. Laing already demonstrated in the Philippines that calendar rhythm users who continued to use their method were as successful in controlling family size as oral contraceptive users who had an early and high discontinuation rate.[126]

Continuation rates with natural family planning generally are higher especially in developing countries than with reversible technological methods,[110] but similar results are found in the U.S. A survey of 9,442 natural family planning users was commissioned by the U.S. Diocesan Development Program for Natural Family Planning in 1987.[127] The survey achieved a 39% response rate; 60% expressed a religious motivation, yet only a third of these couples had received support from their clergy. Seventy-seven (77%) of those who were instructed have continued to use ST or OM methods. Half of the sample had used the method for more than three years, and more than a third had used it for five years. An estimate of unintended pregnancy was 10.5% within the past year. It was not possible to determine whether these were due to perfect or imperfect use of the method, but significantly the wives of limiting couples reported 9.6% unplanned pregnancies while the wives of spacing couples reported 15.1%. More than 80% of respondents reported that they were very satisfied or satisfied with their use of the method.

Dynamics of the Learning Process. There is near unanimity among NFP teachers and users that personal contact between teacher and learner is very important in assisting the woman to recognize her patterns of fertility/infertility, both for factual correctness and for integration of the information into sexual behavior. Marshall reported a trial of the cervical-mucus and BBT methods in which 84 women, who had

been trained in BBT were instructed by correspondence to add the cervical mucus symptom. Of the 22 unintended pregnancies, 13 (59%) were considered to have been method failures, coitus having occurred on "dry" days. The protocol designated the thermal shift as the beginning of postovulatory infertility. The shift had begun 2-12 days from the last act of coitus, obviously calling the designation of "method failure" into question.[81] Flynn and Kelly, commenting on Marshall's methodology, found that personal instruction enabled all their subjects to identify their mucus patterns correctly.[128] The role of the instructor does not end with correct identification of the signs of cyclic physiology. The woman/couple must also be supported in working through the feelings engendered in altering one's self-concept[129,130] and subsequent sexual behavior.

Klaus and Fagan described three phases of learning to integrate periodic abstinence. The first phase focused on learning the mechanics of mucus recognition and the concomitant resentment of the vulnerability engendered by relying on interpretation of mucus without any instrumental intermediary such as a thermometer, calendar, dip stick, etc. After mastering the substrate of the method, most women needed to deal with refusing coitus to their husbands. Initially this was perceived as negative, and the negative feelings were expressed to the teacher of the ovulation method, often with considerable vehemence. Following release of emotional tension, most couples then discovered that they were sharing responsibility for their joint fertility and were not simply refusing one another. The positive aspects of this sharing began to emerge, characterized as a deeper feeling of intimacy consequent to their discontinuing the use of barriers.[131]

Maloof[132] distinguishes behaviors during the fertile phase which either support or hinder the couple in the practice of abstinence when they have decided to delay or avoid pregnancy. He distinguishes four approaches to periodic abstinence:

1) Total avoidance of any physical contact. This generally leads to great dissatisfaction in the marriage and fails to confront the topic of expressing love and tenderness through nongenital means.

2) Mutual arousal without genital union, but often leading to orgasm. He notes that many couples report pregnancies resulting from this behavior, which he ascribes either to loss of semen, as in coitus interruptus, or the unpremeditated completion of the act of coitus when "there is basic disrespect (after arousal) for each other's fertility, and a pregnancy may seem to be the only way to correct the problem, i.e., to teach each other to respect their fertility." He analyzes Tolor's finding of higher pregnancy rates among couples with greater tolerance for diverse sexual patterns as due to the above mechanism.

3) The use of barrier methods or oral or anal intercourse which, by arousing and/ or the use of contraceptive jellies or foams, confuse the recognition of the peak mucus. [Some investigators report higher conception rates with "fertility awareness-mix" than with NFP;[133] others do not.[116]]

4) Learning nuanced expressions of love by distinguishing expressions of tenderness and caressing from behavior intended to arouse the partner (or self) genitally. This is the position of the mature NFP couple.

The witness of couple experience and their progression to autonomy is detailed by Shivanandan,[134] Zimmerman,[135] and Aguilar.[136] All indicate that sexual mastery is not attained instantly, and that at times abstinence can be difficult, even painful. The couples who continue with NFP do so because the positives obviously outweigh the negatives. The considerable variation in continuation and satisfaction rates found in the earlier Studies (Tables 4 & 5) may well reflect the presence or absence of adequate support during the learning phase. Boys' survey found excellent correlations between spouses.[127]

Klann [137] found that the personalities of NFP users were not different from "normal" family planning users, but that the use of NFP enhanced the couple relationship. This was also documented by the anthropologist Violet Kimani, who compared indices of couples' relationship before and one year after beginning to use NFP in Nyahururu, Kenya. Before the study, most (70%) of the women thought that coitus was for the purpose of having children and releasing emotional tension. A year later, the primary purpose of sex was for friendship.[138] Wives now shared equally with husbands in decisions about the education of the children, the disposition of the family income, etc. Some men expressed pride in the self-mastery which they had acquired in the process of learning NFP. One Turkhana man said "I used to be afraid to sleep in the same hut with my wife unless we wanted another child. Now we can sleep in the same bed."[139] Clearly the benefits of natural family planning extend beyond the regulation of conception to the couple relationship.

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APPENDIX

Ways of Identifying Fertility/Infertility

CALENDAR RHYTHM

Calendar Rhythm calculates the fertile and infertile days of the cycle based on the life of the corpus luteum plus sperm survival in cervical mucus.

The most conservative systems assume maximum life for both: 16 days for corpus luteum survival and 5 days putative sperm survival. Thus a woman who knows the length of her last 6 cycles subtracts 21 days from the shortest cycle in order to know the number of early infertile days. Other systems subtract 20 days or 19 days. Since normally, corpus luteum life is no less than 11 days, one may calculate 10 days from the longest previous cycle in order to know the first late infertile day. Some groups subtract 11 days. For example, if one woman's cycles ranged from 27-35 days in length, her last early infertile day would be Day 6 of the cycle and her first late infertile day would be Day 24.

SYMPTO-THERMAL METHODS

Calendar rules are retained to identify the early infertile days, but superseded by any appearance of mucus, which signals the beginning of the fertile phase. **Postovulatory infertility** is identified in the following ways:

A. Rötzer

After peak has been identified, the thermal rise is considered to have occurred if the first two higher temperatures are at least 0.2°F, and the third is at least 0.4°F above the last 6 low temperatures.

B. Coverline

A line drawn 0.1°F above the last 6 low temperatures before the rise. Three consecutive highs at least 0.4°F above the coverline.

C. Vollman

Average all temperatures of the previous month from day 6 until the end of the cycle. Average these to 0.01°F. Draw a line across current cycle at last month's average. The fourth day of rise of the current cycle above the previous average begins the late infertile phase. (Also called the mean intercept.)

D. McCarthy

Peak symptom, cycle length pattern, coverline, *or* running average plus 0.3°F. Applies several variations and advises caution as failure to identify a rise may not indicate anovulation. (See refs. Hilgers and Bauman.)

E. Kippley's Four Basic Rules

1. **Rule C**
   a. third day of full thermal shift
   b. fourth day of drying up or disappearance of mucus
   c. fourth day of cervix closing or lowering may also be used in absence of cervical os monitoring
2. **Rule A** - in the presence of a strong thermal shift, infertility begins on the evening of the 3rd day (or more) of full thermal shift, simultaneously crosschecked by 2 (or 3) days of drying up past the peak day.
3. **Rule B** - used for temperature patterns not as strong or clear as Rule A, and a mucus pattern not as clear of helpful.
   1) evening of 4th day of drying up past peak day,
   2) crosschecked by 3 (or more) days of overall thermal shift past the peak day. All temperatures must be at least 0.1° F. above the pre-shift base line, the last day must be 0.4° F. higher than the baseline.
4. **Rule R** - Postovulatory infertility begins the evening of Peak day + 3 cross checked by 3 days of strong thermal shift. Four or more days of drying up or dryness corroborated by temperature sign of:
   a. at least 3 days of temperatures higher than preovulation base;
   b. these temperatures are in a rising or elevating pattern;
   c. at least one or more of these temperatures has reached the normal thermal shift level of 0.4°F above preovulatory baseline.

Kippley adds calendar calculations for the determination of the early infertile days.

Note: Changed mucus is present after peak in most women. *Peak* is the *last* day of *mucus with fertile characteristics: lubricative, stretchy, clear or cloudy.* See Ovulation Method, below.

OVULATION METHOD

RULES OF THE OVULATION METHOD

To learn the method to avoid pregnancy:

Refrain from intercourse and any genital contact from the beginning of the cycle until the mucus peak has been identified, and for three full days after peak.

Early Day Rules:

1. Avoid days of menstruation
2. **The basic infertile pattern (BIP):**
   a) Dry days after menses are not yet fertile. Alternate evenings of dry days are available for intercourse (early day rule).
   b) There is only one B.I.P. in the average length cycles. There are either dry days or an unchanging discharge, usually slight (desquamated vaginal cells or a small amount of mucus from vaginal epithelium) and producing only a dry or sticky sensation at the vulva, the change from the B.I.P. signifies the start of days of possible fertility.
3. If the days after menstruation are dry, any change in sensation or appearance of a discharge at the vulva signifies possible fertility.
4. When the B.I.P is an unchanging discharge, any change in sensation or appearance at the vulva signifies possible fertility. It requires three average length cycles to become accustomed to this point of change, during which time the couple should confine intercourse to the post-ovulatory days, according to the Peak rule. In the event of a "patch" of mucus — one or more days of non-changing mucus followed by dryness, or if there is any bleeding or spotting outside of menstruation, avoid all days of mucus, bleeding, or spotting, and wait until the fourth *evening* after the last fertile sign to resume intercourse (**the "wait and see" rule**).
5. When ovulation is delayed, so that the pre-ovulatory phase is more than three weeks long, the B.I.P. can then be studied for a period of 2 weeks. It may be:
   i) All dry
   ii) A continuous unchanging discharge, or
   iii) A combination of (i) and (ii)

   The Early Day Rules are applied in all these circumstances.
6. When returning to fertility during or after lactation, wait until the fourth evening after the first two menses.
7. The early day rules apply in all special circumstances: lactation, weaning, premenopause, discontinuation of anovulant medication - any anovulatory state.

The Peak Rule: Wait until the fourth day after peak to resume intercourse. After the peak rule has been observed, there are no rules.

To Achieve Pregnancy: Identify the fertile pattern as above. Intercourse on Peak or the day after is most likely to achieve pregnancy.

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Notes

For NFP Teachers

Foreign and Unfamiliar Journals

Ref. No.	Abbreviation	Title
52	Dtsch Med Wochensch	Deutsche Medizinische Wochenschrift
53	Arch Gynaekol	Archive für Gynaekologie
59	N Z Medical Journal	New Zealand Medical Journal
62	see Ref. #53	
63	Bull. Sloane Hosp. Women Columbia-Presbyt. Med. Cent.	Bulletin of Sloane Hospital for Women Columbia-Presbyterian Medical Center
70	Eur J Obstet Gynaec Reprod Biol	European Journal of Obstetrics, Gynaecology and Reproductive Biology
71	Hosp Progr	Hospital Progress
82	Trop Doc	Tropical Doctor
91	J Urol	Journal of Urology
92	Int J Adol Med	International Journal of Adolescent Medicine
95	J Clin Endoc Metab	Journal of Clinical Endocrinology and Metabolism
101	Endocrinol Res Commun	Endocrinology Research Communications
102	J Reprod Med	Journal of Reproductive Medicine
110	Amer J Obstet Gynec	American Journal of Obstetrics and Gynecology
114	Int J Fertil	International Journal of Fertility
115, 116, 117	Advan Contrac	Advances in Contraception
119	JOGN	Journal of Obstetrical and Gynecologic Nursing
122	Popul Stud	Population Studies
129	Soc Thought	Social Thought
137	Inter J Fertil	International Journal of Fertility

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