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A Prospective Multicentre Study of the Ovulation Method of NFP, III: Characteristics of the Menstrual Cycle and of the Fertile Phase

World Health Organization

Synopsis

A STUDY IS reported of 7,514 menstrual cycles in 725 women of proven fertility (from five centres and four continents) who were sexually active and using no hormonal, IUCD, or barrier methods of contraception. The subjects recorded the presence of cervical mucus at the vulva, and their descriptions were classified into sticky or slippery mucus which was used to categorize various phases of the menstrual cycle.

The mean total length of cycle in 6,472 "normal" cycles was 28.5 days (SD ± 3.18). Cycle length decreased with increasing chronological and gynaecological age. The standard deviation (SD) of cycle length within subjects about their own mean was ± 2.61 days. The mean length of bleeding was 5.0 (SD ± 1.3) days; the mean interval of dry days before onset of mucus was 3.5 (SD ± 2.5) days; the mean duration of mucus discharge was 6.6 (SD ± 2.6) days.

The "peak day" of mucus discharge was defined as the last day on which slippery raw egg white-type mucus was detected,

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and it was taken to indicate the end of the follicular phase. The mean duration of the follicular phase was 15.0 days (± 2.6 days). The post peak phase was defined as the luteal phase, and its mean duration was 13.5 (SD ± 2.8) days.

The fertile period was defined as any day on which mucus was reported before the peak day until three days after the peak. Its mean length was 9.6 (SD ± 2.6) days.

The probability of pregnancy was maximal on the peak day and declined in the days both before and after the peak.

Introduction

The results of the teaching and effectiveness phases of a prospective trial of the Ovulation Method of natural family planning in five countries have been published.[1,2] This study provided an opportunity to analyze the characteristics of the menstrual cycle in a large number of women whose cycles were not influenced by the use of hormonal or other forms of contraception. We now report the various phases of menstrual cycles in women who had successfully learned the Ovulation Method and pay particular attention to the length of the fertile phase and its variability as defined by self-recognition of mucus. We have examined the consequences of acts of sexual intercourse occurring within and outside the defined fertile phase.

Materials and Methods

Subjects

The data for the present analysis are derived from 725 women who entered the effectiveness phase of the multicentre study described in detail previously.[1,2] On the basis of the subjects' descriptions, mucus was classified by the study coordinators in Geneva into two types: one that was thick, sticky, tacky and/or

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cloudy (here called sticky mucus and previously referred to as infertile-type mucus);[3,4] and one which resembled raw egg white and was clear, stretchy, and/or lubricative (here called slippery mucus and previously referred to as fertile-type mucus).[3,4] The last day on which slippery mucus was noticed or on which a wet or lubricative sensation was felt at the vulva was designated as the peak day (PD), whereas the fertile phase commenced on the first day of any recognizable mucus at the vulva, whether sticky or slippery, and ended on PD +4. Clearly this could only be identified as such on the evening of the following day when the absence or changed type of mucus, compared to the PD, would be apparent. The subject then counted the PD as day 0 and was instructed to abstain from intercourse until the evening of PD +4. Figure 1 shows the phases that are defined by the mucus symptom (see p. 8).

We defined the fertile phase, during which couples were advised to abstain from intercourse, as commencing on the first day of any recognizable mucus at the vulva, whether of sticky or slippery type, and ending on PD +4. In addition, couples were advised not to have intercourse on bleeding days and only on every other dry day (i.e., not on two consecutive evenings) prior to the PD so as not to confuse cervical mucus with seminal fluid. We designated a consecutive series of two or more days on which mucus was reported as a "mucus patch." But we omitted from our analysis a "mucus patch" occurring during the luteal phase after the correctly identified PD.

Because the PD is closely related to the estimated day of ovulation,[3,4,8] we defined the follicular phase as extending from the first day of bleeding to the PD and the luteal phase from PD +1 to the end of the cycle.

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The analysis was undertaken at the International Computing Centre, Geneva, using specially written programmes and the Statistical Package for the Social Sciences (SPSS). The statistical techniques used included cumulative percentage frequency distributions, Student's "t" test for the difference between two means, Pearson's correlation coefficient, and Fisher's analysis of variance. We also give the 90% frequency interval which is the range from the 5th to 95th percentile derived from the frequency distributions.

To estimate the variability within subjects and to compare it with the variability between subjects, we rejected those cycles in which there was a pregnancy, in which no PD was indicated, or in which two or more mucus patches were separated by more than one dry day. We rejected all subjects who submitted data for only one cycle. For the remaining cycles, we calculated the mean and standard deviation (SD) of the lengths of the various phases of the cycles for all cycles, for cycles by centre, and for cycles by subject. We calculated two types of SD: the overall, which is based upon all 6,472 cycles, and the "pooled within subject" SD, which is obtained by pooling the SD of the cycles for each individual about her own mean. We also graphed the cumulative percent frequency which demonstrates the shape of the distributions and allows simple calculation of the median and the various percentile ranges.

Results

There were 725 women who recorded 7,514 cycles. Ninety-two women (12.6%) were aged 24 or less; 228 women (31.4%) were 25-29; 243 women (33.5%) were 30-34; and 162 women (22.3%) were 35-39. The mean age was 30.2 years and the mean age by centre varied from 29.1 years in Bangalore to 31.1 years in both Auckland and Dublin. The mean number of pregnancies prior to entry to the study was 3.8 which varied from 3.2 in Manila to 6.1 in San Miguel.

The Cycles

Out of the 7,514 cycles, a pregnancy occurred in 130 (1.8%),

there was no identifiable PD in 200 (2.7%), there was a patch of two or more dry days interrupting the mucus symptom in 702 (9.3%), and 10 were excluded because the subjects reported only one cycle. There remained 6,472 cycles (86.1%) recorded by 687 women which we designated "normal" cycles.

The mean duration of the normal cycles was 28.5 days (SD ± 3.18) and the mean duration of the cycles with no defined peak or with two or more patches of mucus was 29.2 days (SD ± 4.8). The difference of 0.7 days was statistically significant ($t = 6.38$, p 0.001). We did not compare the mucus characteristics in these normal cycles with those in the excluded cycles.

Normal Cycles — Cycle Length

The number of cycles from each centre by duration of cycle—with the mean, median length, and the SD—are shown in table 1. The mean length of 6,472 normal cycles was 28.5 days (SD ± 3.18), the median was 27.7 days, and the range varied from 1 cycle of 14 days to 6 cycles of 50 days or more. The median was 0.8 days shorter than the mean which implies that the distribution is slightly skewed to the upper end with more long cycles than short ones.

The mean cycle length by centres fell into two groups: San Miguel and Dublin had mean lengths of 28.1 and 28.2 days whereas Auckland was 28.6, Bangalore 28.7, and Manila 28.9 days. There was no statistical difference between Dublin and San Miguel nor between the other three centres, but all the differences between Dublin or San Miguel and the other three centres were statistically significant (p 0.01). There seemed to be no apparent pattern to explain these differences and, as the widest difference was only 0.8 days, these are unlikely to be of physiological importance.

The variability of the cycle lengths can be analyzed into two separate components: (1) the women themselves are variable and have different mean cycle lengths which ranged from 22.8 days to 37.7 days (681 out of 687 [99%] fell between 23 and 35 days), and (2) each woman also varies from month to month about her own cycle mean. The first type of variability is between women and the second is within women. The women are less variable between

Table 1
Length of Cycle by Centre
6,472 Cycles in 5 Centres
Number of Cycles by Duration in Days

Duration	Dublin	Bangalore	Auckland	San Miguel	Manila	All centres	Cumulative percentage
days							
22 and under	15	30	7	11	10	73	1.1
23	35	40	5	14	10	104	2.7
24	72	75	29	24	28	228	6.3
25	135	133	49	56	64	437	13.0
26	209	205	75	83	109	681	23.5
27	260	243	125	177	126	931	37.9
28	279	327	124	245	166	1141	55.5
29	225	282	94	157	160	918	69.7
30	144	213	71	106	116	650	79.8
31	89	154	60	50	121	474	87.1
32	83	93	28	19	64	287	91.5
33	48	52	25	12	53	190	94.5
34	20	44	16	17	23	120	96.3
35	21	42	7	3	18	91	97.7
36 and over	28	63	23	10	23	147	100.0
All cycles	1663	1996	738	984	1091	6472	100.0
Median	27.4	27.8	27.6	27.6	28.2	27.7	
Mean	28.2	28.7	28.6	28.1	28.9	28.5	
SD	2.94	3.66	3.24	2.42	3.05	3.18	

their own cycles than would appear from the SD of all cycles, which was 3.18 days; the SD between cycles within women was 2.61 days. This pooled SD within women about their individual means was itself markedly influenced by the few women who had some irregular cycles of over 35 days. Ten percent of women had a SD about their own mean of less than 1 day, over 50% had a SD of less than 2 days, and 80% of less than 3 days, but 4.8% had a SD of 5 days or more.

Cycle Length By Age

The women were divided into four age groups: 18-23, 23-27, 28-32, and 33-39 years of age. The mean cycle lengths were 29.2, 29.0, 28.6, and 27.9 days, respectively. There was no statistical difference between the under 23 years and the 23-27 years group,

but all other differences were statistically significant ($p < 0.001$), and the trend toward shorter cycles with increasing age was also significant.

Pattern of the Cycle

The pattern of the cycle and the mean length (+ SD) of the various phases at each centre are tabulated in table 2 and illustrated in figure 1. Tables 3 and 4 show the frequency distributions for the different phases of the cycles in all 6,472 cycles and figure 2 illustrates the cumulative frequency distributions. The mean length of *bleeding* was 5.0 days for all cycles, but this varied between 4.3 days in Manila and 5.9 days in Dublin; the two centres with the longest bleeding period were the centres in developed countries—Dublin and Auckland. The range of bleeding was from 3 cycles with 1 day to 22 cycles with 10 days or more; the overall SD was 1.3 days and the SD within subjects was 0.7 days; the 90% frequency interval was 2.6 to 6.8 days.

Table 2
Length of Phases of the Menstrual Cycle by Centre
6,472 Cycles in 5 Centres
Mean Length in Days*

Phases of Cycle	Dublin	Bangalore	Auckland	San Miguel	Manila	All Centres
Bleeding Days	5.9 (1.3)	4.7 (1.1)	5.2 (1.3)	4.4 (1.0)	4.3 (1.0)	5.0 (1.3)
Dry Days	1.5 (1.9)	3.7 (1.8)	2.8 (2.2)	4.9 (2.5)	5.1 (2.4)	3.5 (2.5)
Sticky Mucus (infertile-type)	4.1 (2.6)	3.0 (1.4)	3.5 (2.7)	2.3 (1.6)	3.0 (2.3)	3.3 (2.2)
Slippery Mucus (fertile-type)	3.4 (2.0)	3.8 (1.6)	4.3 (2.0)	1.9 (0.7)	3.1 (1.5)	3.3 (1.8)
Fertile Phase	10.5 (2.8)	9.8 (1.8)	10.8 (2.7)	7.2 (1.9)	9.1 (2.6)	9.6 (2.6)
Follicular Phase	15.0 (2.8)	15.2 (2.1)	15.8 (3.0)	13.6 (2.1)	15.6 (2.6)	15.0 (2.6)
Luteal Phase	13.2 (2.1)	13.5 (3.5)	12.8 (2.2)	14.5 (1.8)	13.3 (3.0)	13.5 (2.8)

* Numbers in parentheses are standard deviation. The PD is defined as the last day of slippery (fertile-type) mucus. The fertile phase is defined as the days of sticky mucus + slippery mucus + 3 days. The follicular phase is defined as from day 1 of the cycle up to and including the PD. The luteal phase is defined as from PD + 1 to the onset of the next cycle.

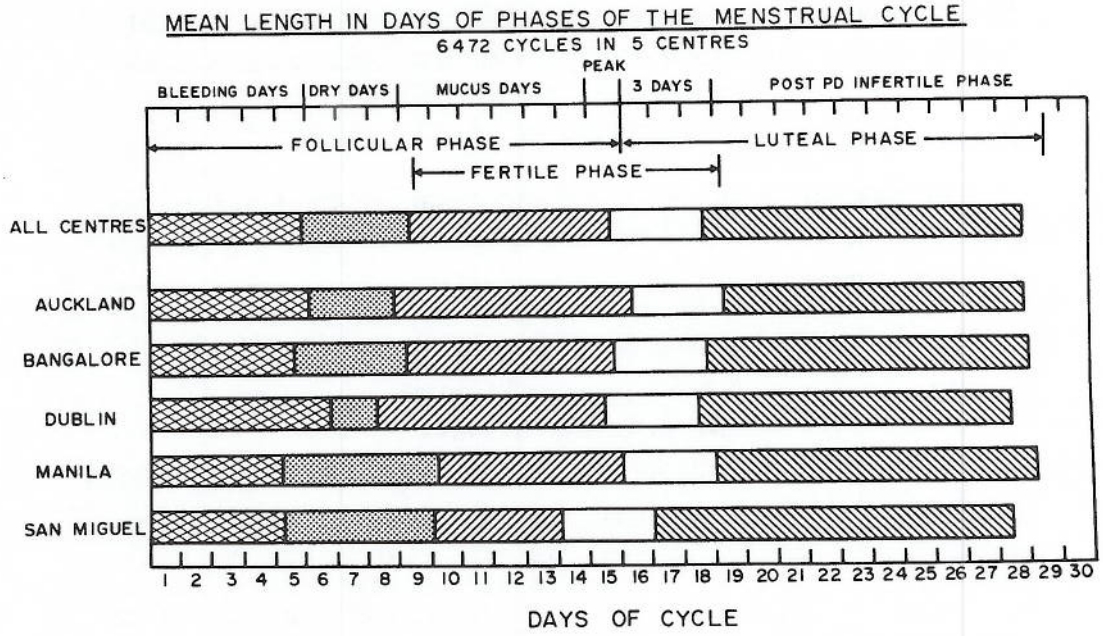

Fig. 1. Mean length in days of phases of the menstrual cycle, for the combined and individual centres. At the top of the figure, the phases defined by the mucus symptoms are shown.

The mean length of *pre-ovulatory dry days* was 3.5 days for all cycles, but this varied between 1.5 days in Dublin and 5.1 days in Manila. The range was from 1,124 cycles without a pre-ovulatory dry day up to 127 cycles in which there were 10 dry days or more. The overall SD was 2.5 days, the SD within subjects was 1.4 days and the 90% frequency interval was 0 to 7.4 days.

The mean duration of *sticky mucus* was 3.3 days which varied from 2.3 days in San Miguel to 4.1 days in Dublin. The range was from 370 cycles without sticky mucus in the follicular phase to 105 cycles with 10 days or more; the overall SD was 2.2 days and the SD within subjects was 1.6 days; the 90% frequency interval was 1.0 to 6.3 days.

The mean duration of *slippery mucus* was 3.3 days and ranged from 1.9 days in San Miguel to 4.3 days in Auckland. The range was from 690 cycles with 1 day only to 64 cycles with 10 days or more; the overall SD was 1.8 days and the SD within subjects was

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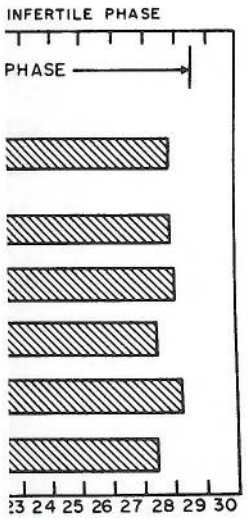

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Table 3
Duration of Phases within the Follicular Phase
in 6,472 "Normal" Cycles
Number of Cycles by Duration in Days

Duration	Bleeding	Dry	Sticky Mucus	Slippery Mucus
days				
0	-	1124	370	-
1	3	417	777	690
2	47	702	1474	1696
3	599	1135	1549	1723
4	1775	1067	934	996
5	2178	781	524	625
6	1128	559	332	360
7	520	290	217	185
8	165	100	126	78
9	35	90	64	55
10 or more	22	127	105	64°
Median	4.4	2.9	2.4	2.5
Mean	5.0	3.5	3.3	3.3
SD	1.28	2.52	2.19	1.80
SD (between cycles within women)	0.71	1.37	1.57	1.19

°Three cycles were unspecified.

1.2 days; the 90% frequency interval was 1.0 to 6.3 days.

Cycle length is divided into two major phases, the follicular and the luteal phase; by definition, the last day of slippery mucus was defined as the PD and marked the close of our definition of the follicular phase. The mean length of the *follicular phase* was 15.0 days; only San Miguel, with 13.6 days, was significantly different from the other centres. The range was from 1 cycle of 5 days to 2 cycles of 30 days; the overall SD was 2.6 days, the SD within subjects was 1.8 days, and the 90% frequency interval was 10.5 to 19.0 days.

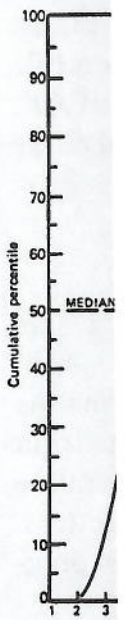
The remainder of the cycle after PD was defined as the *luteal phase* and the mean length was 13.5 days. The mean length of 14.5 days in San Miguel was significantly longer than in the other four centres (Auckland 12.8, Dublin 13.1, Manila 13.3, and Banga-

Table 4
Duration of Phases in the Menstrual Cycle
in 6,472 "Normal" Cycles
Number of Cycles by Duration in Days

Duration	Follicular Phase	Luteal Phase	Fertile Period
5 days or less	1	26	168
6	3	20	479
7	1	59	649
8	20	103	1006
9	44	173	1180
10	130	328	1002
11	257	543	689
12	453	844	518
13	787	1212	301
14	1137	1192	194
15	1147	865	126
16	941	523	66
17	602	241	37
18	375	132	20
19	252	78	16
20	133	42	8
21	83	29	3
22 or more	106	62	10
Median	14.4	12.9	8.8
Mean	15.0	13.5	9.6
SD	2.61	2.79	2.60
SD (between cycles within women)	1.84	2.45	1.60

lore 13.5 days). The range was from 17 cycles with 4 days to 11 cycles with 30 days or more; the overall SD was 2.8 days, the SD within subjects was 2.4 days, and the 90% frequency interval was 8.7 days to 17.2 days.

We defined *the fertile period* as those days on which any mucus, sticky or slippery, was detected plus three days after the PD. The mean length of this fertile period was 9.6 days, which varied between 7.2 days in San Miguel and 10.8 days in Auckland. The range was from 19 cycles with 4 days to 1 cycle with 28 days; the SD was 2.6 days, the SD within subjects was 1.6 days, and the 90% frequency interval was 5.3 to 13.8 days.



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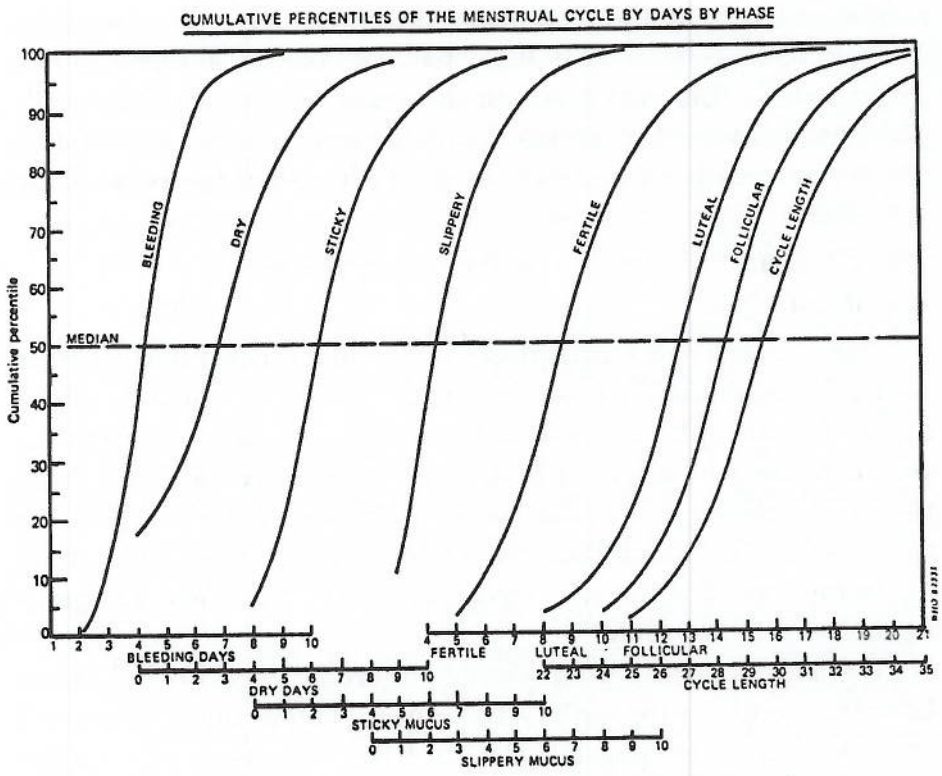

Fig. 2. The cumulative percentiles of the various phases of the cycle, in days.

Data on the relationship between the PD and the day of maximum mucus secretion was available in 6,171 cycles. In 3,328 cycles (53.9%), these days were reported as being the same, but there were wide differences between centres: Bangalore, 81.8%; Dublin, 61.1%; Manila, 47.8%; Auckland, 31.5%; and San Miguel, 14.8%.

Correlations Between Phases of the Cycle

When examining the correlations between the phases of the cycle, it is necessary to recall that a part must necessarily be correlated with the whole and, therefore, the follicular and luteal phases must be correlated with the cycle length. The following was observed: The correlation between follicular phase and cycle length was 0.55, and the correlation between luteal phase and cycle length was 0.62. The luteal phase was negatively correlated with the follicular phase (r = -0.31), which implies that a long follicular phase

is followed by a short luteal phase and conversely. There was also a negative correlation (r = -0.18) between the luteal phase of one cycle and the follicular phase of the next. The length of the fertile phase was positively correlated with the follicular phase (r = 0.62), but it was negatively correlated with the length of the luteal phase (r = -0.26).

The Changing Probability of Pregnancy during the Menstrual Cycle

The concept of a fertile phase and of an infertile phase or "safe period" is essentially a probabilistic definition by which the probability of conception following intercourse is maximal during the fertile phase and minimal during the infertile phase. Data from this study allows us to make some estimates of the comparative probabilities, although this was not one of our primary objectives.

In the report of the effectiveness phase of this study, 130 pregnancies were recorded.[6]

We had information on whether intercourse occurred but not how frequently in the early "safe" phase (before onset of mucus) or in the late "safe" phase (PD +4 or later); we asked only for the day of the last and first act, respectively, in these phases. However the day of every act of intercourse during the fertile phase was to be recorded. These details were assessed by the teachers and the subjects once every cycle. We had to assume that the subjects honestly recorded all acts during the fertile phase. Since the women in San Miguel were reticent to disclose this information to the teachers, as we noted previously,[2] we excluded this centre from the analysis.

As a first approximation to calculating the probability of pregnancy, the following criteria were observed:

(1) In pregnancy cycles where there was a single act of intercourse recorded during the fertile phase and where the PD was indicated, that act was assumed to have led to the pregnancy even when there were acts at the boundaries of the fertile phase (i.e., on last day before mucus or on PD +4).

(2) In pregnancy cycles in which more than one act was recorded in the fertile phase, that act nearest to the PD was selected (which occurred on 14 occasions). If two acts were equally spaced around the PD, the act before PD was selected (on 7 occasions).

(3) In nonpregnancy cycles, each single act within the fertile phase was counted as "at risk." In 4 cycles, there were repeated acts in the same segment of the fertile period; in 14 cycles, there were acts both before and after the PD.

(4) Pregnancy and nonpregnancy cycles were excluded from this analysis when the PD was not identifiable, when there was an inadequate description of the type of mucus, when the day of intercourse within the fertile phase was not stated, or when intercourse occurred using a condom or with withdrawal (5 cycles).

(5) When no act was recorded in the fertile phase but an act was recorded before or after this phase, the cycle was considered to be "at risk" irrespective of the frequency of intercourse or the timing. The probability of pregnancy was calculated for each day relative to the PD and separately for both types (sticky and slippery) of mucus (table 5).

The probability of pregnancy in the presence of sticky mucus was 0.024 on PD -4 or earlier but rose to 0.500 on PD -3 to PD -1. In the presence of slippery mucus, the risk was 0.353 on PD -4 or earlier and rose to 0.546 on PD -3 to PD -1. There were 9 acts recorded on the PD out of the 7,514 cycles, which resulted in 6 pregnancies, which gives a pregnancy probability of 0.667.

In the post peak period, the probability declined from 0.444 on PD +1 to 0.205 on PD +2 to 0.089 on PD +3.

Outside the fertile phase, the probability was 0.004 per cycle.

Discussion

This report describes the first prospective international study of the characteristics of the menstrual cycle and the fertile phase as defined by self-recognition of the cervical mucus discharge

Table 5
Probability of Pregnancy by Phase of Cycle and Days from "Peak" Day*

Phase of Cycle	Days Relation to PD	Cycles with Intercourse	Number of Pregnancies	Probability of Pregnancy
Sticky Mucus	PD-4 or earlier	81	2	.024
Sticky Mucus	PD-3 to PD-1	6	3	.500
Slippery Mucus	PD-4 or earlier	17	6	.353
Slippery Mucus	PD-3 to PD-1	22	12	.546
Peak Day	PD 0	9	6	.667
Post Peak	PD+1	18	8	.444
Post Peak	PD+2	44	9	.205
Post Peak	PD+3	112	10	.089
Outside Fertile Period	-	6158	22	.004
All Phases	-	6467	78	.012

* All cycles and all pregnancies (29) from San Miguel were excluded. Twenty-three pregnancies from the other four centres were excluded: 18 provided inadequate data concerning the date of intercourse and 5 cases had intercourse using withdrawal or a condom. There were only 178 cycles in four centres in which no act of intercourse was recorded.

detected at the vulva. Billings et al.[3] and Hilgers and Prebil[5] reported the onset of mucus 6 days before the peak symptom; Hilgers et al.[8] gave a mean interval of 6.3 days before the peak, and our study gives 5.6 days (sticky mucus + slippery mucus -1). The general conclusion is that, on the average, the duration of mucus that will be observed by women instructed in this method will be about 6 days before the PD. But it is important to note that in 18 cycles (0.3%) there was no mucus observed before the PD, in 149 (2%) there was only 1 day of mucus before the PD, in 479 (7%) there were 2 days of mucus, and in 649 cycles (10%) there were 3 days of mucus. Thus, in about 20% of all cycles, there are only 3 days of mucus or less before the PD.

Previous investigators[10,11] have reported an inverse correlation between the length of the follicular and luteal phases of the normal menstrual cycle when these have been defined by the basal temperature or by LH peak measurements. Our study has con-

firmed that this negative correlation can be observed in selected cycles when the phases are defined by self-observation of cervical mucus. We have also demonstrated a weak inverse correlation between the length of the luteal phase in one cycle and the follicular phase of the following cycle which may indicate a constancy between the days of ovulation in successive cycles.

Our subjects had been selected because they had a previous history of cycles of 23 to 35 days and had had a previous conception, consequently, the results cannot be compared with other large series in which menstrual cycle length and its variability have been examined. In particular, we noted a correlation between cycle length and the lengths of both the follicular and the luteal phases. Among these selected subjects, there were too few long cycles to show the anticipated dependence of cycle length on follicular rather than luteal phase duration. Our series, however, does confirm other reports[9,10] that the menstrual cycle length decreases slightly with increasing chronological and gynaecological age until the approach of the menopause.

The mean cycle lengths found at each of our centres were formally and significantly different (p 0.01), but these differences were small and probably of no biological significance. In Bangalore, however, some women occasionally took hormones at the end of a cycle to delay menstruation so that they could participate in festivities from which they would be excluded if menstruating. The full extent to which this occurred in our study is not known although this was indicated on some of the charts. This practice might also explain the greater SD in the luteal phase and in cycle length in Bangalore compared to other centres.

Data on the relationship between the PD and the day of maximum mucus secretion confirmed the findings of Billings[7] that the former is not necessarily the same as the latter. In our study they coincided in only 53.9% of the cycles investigated.

This study also allowed us to evaluate whether the detection of mucus discharge at the vulva defines the fertile phase and whether the probability of pregnancy differs in the presence of

sticky or slippery mucus. Our analysis indicates a probability of pregnancy per cycle of about 0.004 outside the fertile phase as defined by the Ovulation Method, which rises to a maximum of 0.667 on the PD and declines steeply during the following 3 days. Thus, the method does effectively define the fertile phase.

The difference in probability of pregnancy from intercourse in the presence of sticky or of slippery mucus is not great; in the 3 days before the PD (PD-3 to PD-1), the probability of pregnancy in the presence of sticky mucus was 0.500 and in the presence of slippery mucus, 0.546. Both these results are based upon small numbers, and the differences were not statistically significant. But it is important to note that there is a substantial probability of pregnancy if intercourse occurs in the presence of sticky (previously called infertile-type) mucus, which has important implications in the teaching of the methods and which has been noted elsewhere.[12] It appears that proximity to the PD is a more reliable indicator of fertility than the characteristics of the mucus discharge before the PD as perceived by the woman.

The method we have used, however, does not at this stage allow us to compare our results with other reports. All of our subjects were fertile, with regular ovulatory cycles who were having intercourse in almost all cycles. We are not entirely confident that we obtained a complete record of all acts of intercourse in the fertile period especially in the nonpregnancy cycles. In Bangalore and San Miguel, there were no pregnancies; in Manila, there was only one pregnancy which occurred when no act of intercourse was reported during the fertile phase, whereas in Dublin there were 8, and in Auckland there were 7 pregnancies to couples who claimed to have abstained during the fertile phase. This may be because (1) the fertile phase was more difficult to identify in these centres, (2) the teaching of the method or the questioning with regard to intercourse may have been less thorough, or (3) couples may not have been prepared to report intercourse honestly during the fertile phase. In Dublin and Auckland, there were more mucus days and bleeding days so that the days available for intercourse were considerably reduced.

There is also likely to be a differential bias in under-reporting intercourse or genital contact in nonpregnancy cycles compared to pregnancy cycles. Although questions on intercourse were asked after every cycle, there was a special report paying extra attention to possible genital contact which was prepared by the teachers when pregnancy was known to have occurred. The result of this would be to under-report intercourse relatively in nonpregnancy cycles and, hence, increase the apparent probability of pregnancy.

Our maximum conception rate occurred on the PD; out of the 7,514 cycles, there were only 9 cycles in which intercourse was reported on the PD, and these resulted in 6 pregnancies, a pregnancy rate of 0.667. Using the day of rise (D) in basal body temperature as an index of ovulation, Barrett and Marshall[13] found a maximum probability on D-2 of 0.30, where a conceptus had to survive 6 weeks to be included in their study. Schwartz et al.[14] found a maximum daily probability of conception alone of 0.65 and a maximum probability of fertilization—with pregnancy lasting at least 6 weeks—of 0.34, both on D-2. Royston[15] also found a similar probability of conception leading to pregnancy for at least 6 weeks of 0.36 on D-2. Schwartz et al.[14] estimated only 52% of eggs exposed to the possibility of fertilization gave a conceptus of at least 6 weeks' viability. Our method has not permitted us to make separate estimates of fertilization and 6-week pregnancy probabilities, but our conception rates are so high that it is clear that our loss of fertilized ova cannot be nearly as high as that reported by Schwartz et al.[14] or by Leridon.[16] We propose to use the method of Royston to analyze our results in more detail to obtain comparable estimates in the future.

The study also emphasizes two features concerning the probability of pregnancy. In four centres, there were only 309 cycles (4.8%) out of 6,467 in which intercourse was reported during the fertile phase, with 56 pregnancies resulting. In contrast, there were 6,158 cycles in which intercourse occurred during the nonfertile phase and, although the pregnancy rate at 0.004 was low, the number of pregnancies was 22. There need be only a few de-

partures from the rules of the Ovulation Method to raise the pregnancy rate very sharply, but the observed probability of pregnancy even in the nonfertile phases, as defined by the Ovulation Method, is not negligible on the assumption that acts of intercourse during the fertile phase were accurately reported.

It must be recalled that all these results are based upon the self-observation of mucus symptoms by women from Europe, Latin America, India, East Asia, and Australia varying in race, education, social status, and cultural background. These studies are not based upon any objective criteria of ovulation, but further studies are being organized to define correlations between the subjective symptoms of the fertile phase and the hormonal changes in luteinizing hormone, estrogen, and progesterone that may explain these observations and clarify some of the differences found.

The probability of pregnancy correlates very well with the self-identification of the PD. The interval which includes the days of mucus before the PD and the 3 post-peak days adequately distinguishes the fertile from the infertile phase of the menstrual cycle, and this has important implications not only for family planning methods based upon periodic abstinence but also for the diagnosis and management of infertility.

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