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# Natural conception rates in subfertile couples following fertility awareness training

**P. Frank-Herrmann[1] · C. Jacobs[1] · E. Jenetzky[2] · C. Gnoth[3] · C. Pyper[4] · S. Baur[3] · G. Freundl[3] · M. Goeckenjan[5] · T. Strowitzki[1]**

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**Abstract**
*Purpose* To analyze cumulative pregnancy rates of subfertile couples after fertility awareness training.
*Methods* A prospective observational cohort study followed 187 subfertile women, who had received training in self-observation of the fertile phase of the menstrual cycle with the Sensiplan method, for 8 months. The women, aged 21–47 years, had attempted to become pregnant for 3.5 years on average (range 1–8 years) before study entry. Amenorrhea, known tubal occlusion and severe male factor had been excluded. An additional seven women, who had initially been recruited, became pregnant during the cycle immediately prior to Sensiplan training: this is taken to be the spontaneous pregnancy rate per cycle in the cohort in the absence of fertility awareness training.
*Results* The cumulative pregnancy rate of subfertile couples after fertility awareness training was 38% (95% CI 27–49%; 58 pregnancies) after eight observation months, which is significantly higher than the estimated basic pregnancy rate of 21.6% in untrained couples in the same cohort. For couples who had been seeking to become pregnant for 1–2 years, the pregnancy rate increased to 56% after 8 months. A female age above 35 (cumulative pregnancy rate 25%, $p=0.06$), couples who had attempted to become pregnant for more than 2 years (cumulative pregnancy rate 17%, $p<0.01$), all significantly reduce the chances of conceiving naturally at some point.
*Conclusions* Training women to identify their fertile window in the menstrual cycle seems to be a reasonable first-line therapy in the management of subfertility.

**Keywords** Subfertility · Pregnancy rate · Natural family planning · Fertility awareness method · Sensiplan

✉ P. Frank-Herrmann
petra.frank-herrmann@med.uni-heidelberg.de

[1] Department of Gynecological Endocrinology and Fertility Disorders, University of Heidelberg, Im Neuenheimer Feld 440, 69120 Heidelberg, Germany

[2] Department for Child and Adolescent Psychiatry and Psychotherapy, University Medical Center, Langenbeckstr. 1, 55131 Mainz, Germany

[3] Section Natural Fertility, German Society of Gynecological Endocrinology and Fertility Medicine, University of Heidelberg, Im Neuenheimer Feld 440, 69120 Heidelberg, Germany

[4] National Perinatal Epidemiology Unit, Nuffield Department of Public Health, University of Oxford, Old Rd, Oxford OX3 7LF, UK

[5] Department of Gynecology and Obstetrics, University of Dresden, Fetscherstraße 74, 01307 Dresden, Germany

## Introduction

### Background

Sexual intercourse has to take place within the fertile window of the woman's cycle to make the most of a particular couple's natural conception potential. For most women, even those with relatively regular menstrual cycles, the time of ovulation and the fertile window vary markedly. More than half of the women in a normal population have a variation in cycle length and fertile window of at least 1 week observed over 1 year [1–4]. This is no problem if couples have intercourse every 1–2 days throughout the whole cycle, as recommended by the ASRM in 2008 [5]. However, this frequency is not reached in reality especially over longer periods of time [6, 7]. This means that couples may be inaccurate in

timing sexual intercourse to occur during the woman's fertile time. Many couples trying for pregnancy believe that they are most fertile around day 14 and target frequent intercourse between days 10 to 16; they are then likely to have a reduced frequency of sexual intercourse from day 17 onwards [1]. But in a 33-day cycle, peak fertility may occur at around day 20. Therefore, inaccurate timing of sexual intercourse may be a reason for delay in conception or ongoing subfertility, indicating the need for accurate fertility awareness education.

The natural family planning (NFP) method called Sensiplan is a fertility awareness method (FAM) that enables a woman to accurately identify her fertile time [8]. Women observe and interpret cycle symptoms, mainly cervical secretion changes and basal body temperature, which have been proven to be reliable indicators of the fertile window [1, 9–13]. The Sensiplan method's guidelines are evidence based and have been developed following extensive fertility research carried out over the last 25 years [13]. They have been adopted and disseminated by several European NFP groups [1, 8, 14]. This paper describes a study cohort of subfertile couples who were trained to identify the fertile phase of the menstrual cycle using the Sensiplan method.

Correlation studies have shown that estimates of peak fertility and ovulation based on cervical secretions and basal body temperature rise have a high probability of being within 1–2 days of true ovulation (detected by ultrasound and LH peak) [2, 9, 10, 15, 16]. Several probability-of-conception studies have identified the fertile phase as beginning 5 days prior to ovulation, and extending to the day of ovulation [17–20]. Furthermore, these studies found that timing intercourse to occur on days with good cervical secretion quality was more important for achieving pregnancy than planning sexual intercourse to coincide with the time of likely ovulation [17, 21].

There is some evidence that fertility awareness education shortens the time-to-pregnancy (TTP): a prospective cohort TTP study followed up 340 healthy German women using the Sensiplan method from their first cycle trying for pregnancy. The pregnancy rates at 1, 3, 6 and 12 cycles were 38, 68, 81 and 92%, respectively [22]. In their guidelines on "Optimizing natural fertility" the American Society for Reproductive Medicine (ASRM) cites this German study in relation to the good results on the spontaneous achievement of pregnancy following unprotected intercourse [5, 23]. However, it was not explicitly mentioned that those rates were achieved by women who had been trained in fertility awareness methods, i.e., who knew how to identify their fertile window precisely.

Around 9% of couples fail to conceive within 12 months of trying [24, 25]. Increasingly these couples are being referred to assisted reproductive technology (ART) clinics for subfertility treatment. There is a paucity of data related to pregnancy rates in subfertile women who use fertility awareness methods (FAM) [26–28].

### Objectives

The primary aim of this study was to determine the cumulative spontaneous conception rate after subfertile couples were trained to identify their fertile window.

A secondary aim of the study was to explore whether the planning and implementation of diagnostic tests for subfertility can be performed more efficiently if the fertile window is identified; the results of this investigation will be presented in another paper.

## Materials and methods

The study was conducted between 2004 and 2008 by the Department of Gynecological Endocrinology and Fertility Disorders of the Women's Hospital of the University of Heidelberg/Germany. The purpose of this exploratory study with high external validity was to estimate the efficiency of the Sensiplan method of fertility awareness in aiding subfertile couples to achieve natural conception.

### Inclusion criteria

Participating couples in this prospective cohort study were selected according to the following criteria:

- at least 1 year of unsuccessfully trying to conceive
- absence of amenorrhea
- currently receiving no subfertility treatments
- willing to learn and use the Sensiplan method of fertility awareness
- willing to participate for at least two cycles and to complete and deliver two FAM charts
- willing to fill out three questionnaires over the course of the study. The questionnaires were designed to collect information on prior medical history relating to subfertility as well as user satisfaction and competence in use of the FAM method.
- no known tubal occlusion
- no known severe OAT (oligoasthenoteratozoospermia, OAT III).

### Study design

During the first study consultation, information was collected about each woman's previous and current medical and reproductive history, and on their fertility awareness knowledge. The charting and use of the Sensiplan method was also explained. The observation period started with the

following menstrual period. After the first cycle, a follow-up consultation was carried out by telephone to enable the women to discuss their first cycle chart. The women were asked to return for diagnostic tests during a subsequent cycle. Basic subfertility investigations were carried out during that cycle, including a day 2–5 basic hormonal profile (blood test). When the patient observed clear, stretchy, and slippery cervical secretions for the first time in that cycle, she underwent a transvaginal ultrasound investigation the following day and blood test was taken to monitor periovulatory hormonal levels. A third blood test was taken 1 week later to monitor the hormonal levels of the luteal phase. 83% of male partners had a basic semen analysis.

All couples were requested to stay in the study until they achieved pregnancy or for up to 8 months. The first chart and the chart of the diagnostic cycle were collected. Some participants had already scheduled ART treatments when they became part of the study, and were observed for a smaller number of cycles before moving on to ART. All study pregnancies were confirmed by temperature charts and by ultrasound.

### The fertility awareness method

The Sensiplan method consists of recording the pattern of cervical secretion and changes in basal body temperature. Women are trained to observe the presence and type of cervical secretions from the vulva over the course of the day and record sensation and appearance of the secretions prior to going to bed at night. Basal body temperatures were measured in the morning after waking up. Self-observation of the cervical secretions serves as a predictive marker for ovulation and is confirmed by a temperature rise, which indicates the closing of the fertility window. The beginning and the end of the fertile time are determined in the following way, and can be considered 'rules' for couples trying to conceive (The guidelines for achieving pregnancy differ from those for avoiding a pregnancy):

- The beginning of the fertile time is identified by the first appearance or sensation of cervical secretions on the vulva and lasts until the third day after the peak day of secretions.
- The end of the fertile time is additionally confirmed by the rise in basal body temperature related to the progesterone surge. The temperature rise is recognized by three higher readings, all three higher than the previous six readings and the last one 0.2 °C higher than the previous six. The elevated temperature retrospectively indicates ovulation has occurred; the temperature remains elevated until the next menstruation [29, 30].

The methodology is described in detail elsewhere [29].

The behavioral advice given to couples who wish to conceive is that conception is likely to be highest on those days when clear, stretchy, and slippery secretions are present, as well as on the two consecutive days following this time. Sexual intercourse should be targeted on days when cervical secretions are present and for 2 days after the peak secretion day, up to the first higher temperature reading, even if secretions are no longer present. Couples are told that they may have intercourse as frequently as they like. It is recommended that intercourse should occur at least every 2 or 3 days during the fertile window.

### Statistical analysis

Statistical analyses were performed with SPSS 22 and BiAS for Windows 10. Because the study length of eight cycles precluded calculation of the median cycle rate for becoming pregnant, we report the mean cycle rate. The main results are purely descriptive, with absolute and relative frequencies, Kaplan–Meier curves and stratified life tables. The Hall–Wellner method was used to produce a 95% confidence interval. It should be noted that we use the odds ratio instead of the appropriate term, "relative hazard", for pregnancy incidence.

As inference statistics we applied Cox regression with difference as contrast for stratified age and time-to-pregnancies. Further, we used Cox regression to adjust for real age in years in the description of women who became pregnant despite secondary subfertility diagnoses such as endometriosis. We stratified our results for duration of childlessness and age of the woman according to the relevance of subfertility co-factors [31].

Due to the study's exploratory nature, we did not adjust for multiple testing of each subject.

### Study population

In total, 194 patients were recruited into the study. One-third of the cohort was recruited via the Subfertility Clinic at the Women's Hospital of the University of Heidelberg; the other couples were recruited via advertisements in the local newspaper. Seven women (3%) became pregnant during the last cycle before starting Sensiplan and were hence excluded from the study, so that the study population consisted of 187 women who had been trying for pregnancy for at least 1 year before study entry. We did not exclude cases with diminished male fertility (except OAT III if known).

51% of the participants were 35 years or younger (Table 1). Their ages ranged from 21 to 41 years, with a mean of 34.7 (SD = 4.9 years) and a median of 35.

48% of the participants had been trying to conceive for at least 3 years (mean of 3.5 years).

**Table 1** Age, education and years seeking to become pregnant ($n = 187$ women)

| | Frequency ($n$) | Frequency (%) |
|---|---|---|
| Age (years) | | |
| ≤35 | 96 | 51.3 |
| 36–40 | 75 | 40.1 |
| >40 | 16 | 8.6 |
| Education | | |
| Low level | 14 | 7.5 |
| Medium level | 112 | 59.9 |
| University degree | 61 | 32.6 |
| Years seeking to become pregnant before study entry | | |
| 1–2 | 98 | 52.4 |
| 3–4 | 59 | 31.6 |
| ≥5 | 30 | 16.0 |

**Table 2** Reasons for subfertility ($n = 187$ women, multiple reasons possible)

| | Frequency ($n$) | Frequency (%) |
|---|---|---|
| Endocrine reasons | 83 | 44.4 |
| Male factor | 44 | 23.5 |
| Idiopathic | 36 | 19.3 |
| Tubal factor | 33 | 17.6 |
| Endometriosis | 15 | 8.0 |
| Uterine pathology | 28 | 15.0 |
| Other | 22 | 11.8 |

**Table 3** Reasons for study drop-out ($n = 187$ women)

| | Absolute frequency ($n$) | Relative frequency (%) |
|---|---|---|
| Pregnancy | 58 | 31.0 |
| End of study (8 months reached) | 71 | 38.0 |
| Starting infertility treatment | 25 | 13.4 |
| Pregnancy no longer possible (menopause, amenorrhea, hysterectomy) | 6 | 3.2 |
| Lack of time/personal stress | 15 | 8.0 |
| Problems with the Sensiplan method | 4 | 2.1 |
| No longer seeking to become pregnant | 6 | 3.2 |
| Lost-to-follow-up | 2 | 1.1 |

81% of the women had never been pregnant prior to the study. 11% had already given birth to one or more children with the same partner, 4% with another partner, and 9% had undergone one or more abortions.

96% had received no prior instruction on monitoring cervical secretions.

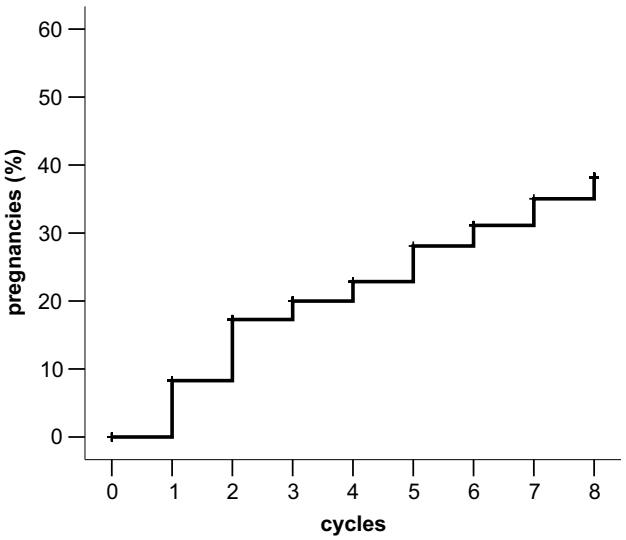


**Fig. 1** Cumulative natural conception rate after Sensiplan training ($n = 187$ subfertile women)

Based on the results of the tests of the diagnostic cycle, the couples were classified according to their subfertility diagnosis (Table 2).

## Results

69% ($n = 129$) of the study participants completed the study, i.e., they either completed 8 months or became pregnant. 31% of the couples discontinued from the study prior to completing eight cycles, primarily due to their commencing subfertility treatments (fertility awareness training was offered to them while they were on the ART waiting list). Only 2% of the women withdrew due to problems related to learning about self-observation of cervical secretions and/or monitoring their basal body temperature. Another 3% of the women discontinued the study because it was identified that pregnancy was no longer possible and a further 3% decided they no longer wished to achieve a pregnancy. The low lost-to-follow-up rate of 1% indicates good study implementation (Table 3).

### Spontaneous pregnancy rate with fertility-focused intercourse

The cumulative spontaneous pregnancy rate with fertility focused intercourse was 38% (95% CI 27–49%) after 8 months of observation (Kaplan–Meier curve with 58 pregnancies) which is above the estimated spontaneous pregnancy rate without fertility awareness training (Fig. 1). The mean time-to-pregnancy was 6.4 cycles.

The 3% spontaneous pregnancy rate during the cycle directly preceding the training cycle may be considered the spontaneous pregnancy rate for one cycle without fertility awareness training. This gives the basic, intrinsic, cumulative pregnancy rate of up to 21.6% during the eight cycles of study duration ($p = 1-(1-0.03)8$, conservatively calculated; power to basis 0.97 or 0.978 cycle) for statistical comparisons.

### Spontaneous pregnancy rate depending on age

The spontaneous pregnancy rate depending on age is presented in Table 4 and Fig. 2. The women were stratified into three age groups (below 36, 36–40 years and above 40 years). Women 35 years or younger achieved significantly more spontaneous pregnancies than women aged 36 and above (log-rank test, $p=0.018$). For those under 36 years, the probability of spontaneous conception after 8 cycles was 51%; for 36–40 year-olds it was 25% and 20% for those over 40 years.

If age is considered as metric variable in a Cox regression model, the chance of becoming pregnant was reduced by about 8% with each passing year [$p=0.001$; Odds ratio 0.92 (95% CI 0.87–0.97)].

### Spontaneous pregnancy rate depending on the duration of subfertility

The participants were also stratified into three groups according to the length of time spent attempting to achieve pregnancy prior to the study (1–2 years, 3–4 years, more than 4 years). For those couples trying to become pregnant over the previous 1 to 2 years, the pregnancy rate increased to 56% 8 months after Sensiplan training (significantly different to the basic pregnancy rate, $p<0.001$ in the log-rank test) (Table 5; Fig. 3). Amongst the couples who had tried to achieve pregnancy for between 3 and 4 years, there was a spontaneous pregnancy rate of 20% after 8 months

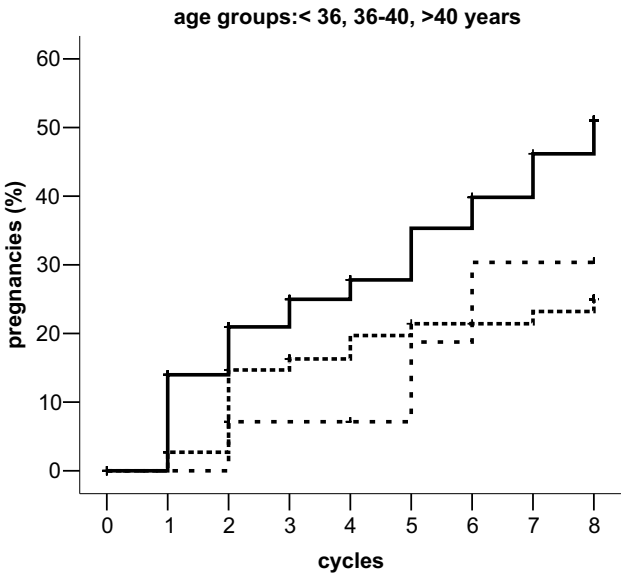


**Fig. 2** Cumulative natural conception rate in different age groups after Sensiplan training ($n=187$ subfertile women)

(Kaplan–Meier). Amongst those couples with more than 5 years of subfertility, three pregnancies occurred spontaneously (11%), all shortly after receiving fertility awareness teaching.

The basic, intrinsic pregnancy rate of up to 21.6% without fertility awareness training is estimated from the seven women who became pregnant during the last cycle before starting Sensiplan, 6 of them attempting to achieve pregnancy since 1–2 years and 1 since 3 years.

There is a significant relationship between these two ordinal variables (Kendall's tau 0.22, $p=0.001$). If age and length of time seeking pregnancy are each stratified into three groups and considered together as categorical variables in a Cox regression model (with difference as contrast), seeking pregnancy for more than 2 years seems to be the most important factor [$p=0.006$; Odds ratio = 0.38

**Table 4** Cumulative probability of natural conception in different age groups after Sensiplan training ($n=187$ subfertile women)

| Cycle | Women at chance (*n*) | | | Cumulative number of pregnancies | | | Cumulative probability of conception (SE) | | |
|---|---|---|---|---|---|---|---|---|---|
| | <36 years | 36–40 years | >40 years | <36 years | 36–40 years | >40 years | <36 years | 36–40 years | >40 years |
| 0 | 96 | 75 | 16 | 0 | 0 | 0 | – | – | – |
| 1 | 93 | 74 | 14 | 13 | 2 | 0 | 0.14 (0.04) | 0.03 (0.02) | 0 |
| 2 | 74 | 65 | 14 | 19 | 10 | 1 | 0.21 (0.04) | 0.15 (0.04) | 0.17 (0.07) |
| 3 | 59 | 53 | 10 | 22 | 11 | 1 | 0.25 (0.05) | 0.16 (0.05) | 0.17 (0.07) |
| 4 | 53 | 49 | 10 | 24 | 13 | 1 | 0.28 (0.05) | 0.20 (0.05) | 0.17 (0.07) |
| 5 | 48 | 47 | 8 | 29 | 14 | 2 | 0.35 (0.05) | 0.21 (0.05) | 0.19 (0.12) |
| 6 | 43 | 45 | 7 | 32 | 14 | 3 | 0.40 (0.06) | 0.21 (0.05) | 0.20 (0.15) |
| 7 | 38 | 44 | 6 | 36 | 15 | 3 | 0.46 (0.06) | 0.23 (0.05) | 0.20 (0.15) |
| 8 | 33 | 43 | 6 | 39 | 16 | 3 | 0.51 (0.06) | 0.25 (0.06) | 0.20 (0.15) |

**Table 5** Cumulative probability of natural conception after Sensiplan training by duration of subfertility ($n = 187$ women)

| Cycle | Women at chance ($n$) | | | Cumulative number of pregnancies | | | Cumulative probability of conception (SE) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1–2 years | 3–4 years | ≥5 | 1–2 years | 3–4 years | ≥5 | 1–2 years | 3–4 years | ≥5 years |
| 0 | 98 | 59 | 30 | 0 | 0 | 0 | – | – | – |
| 1 | 95 | 58 | 28 | 11 | 4 | 0 | 0.12 (0.03) | 0.07 (0.03) | 0 |
| 2 | 77 | 49 | 27 | 21 | 6 | 3 | 0.23 (0.04) | 0.11 (0.04) | 0.11 (0.06) |
| 3 | 62 | 40 | 20 | 24 | 7 | 3 | 0.27 (0.05) | 0.13 (0.05) | 0.11 (0.06) |
| 4 | 56 | 37 | 19 | 27 | 8 | 3 | 0.31 (0.05) | 0.15 (0.05) | 0.11 (0.06) |
| 5 | 51 | 34 | 18 | 34 | 0 | 3 | 0.40 (0.05) | 0.15 (0.05) | 0.11 (0.06) |
| 6 | 44 | 33 | 18 | 37 | 9 | 3 | 0.44 (0.06) | 0.18 (0.06) | 0.11 (0.06) |
| 7 | 40 | 31 | 17 | 41 | 10 | 3 | 0.50 (0.06) | 0.20 (0.06) | 0.11 (0.06) |
| 8 | 35 | 30 | 17 | 45 | 10 | 3 | 0.56 (0.06) | 0.20 (0.06) | 0.11 (0.06) |

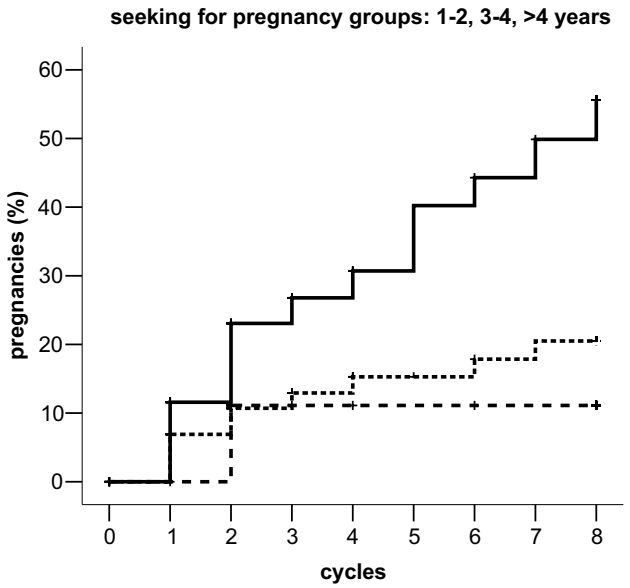


**Fig. 3** Cumulative natural conception rate after Sensiplan training by duration of subfertility ($n = 187$ subfertile women)

(95% CIs 0.19–0.97)]. Despite the limitations of our study sample, we observed that seeking pregnancy for more than four years [$p = 0.095$; Odds ratio = 0.36 (95% CI 0.11–1.19)] and age greater than 35 years [$p = 0.069$; Odds ratio = 0.57 (95% CI 0.32–1.04)] seemed to reduce the chance of becoming pregnant by half. We saw no reason to stratify below and above 40 years of age ($p = 0.672$), and hence we present the pregnancy rates of two age groups, up to 35 years of age and above 35 years of age (see Table 4).

### Spontaneous pregnancy rate in secondary infertility

No significant difference was found between the pregnancy rates of women with primary vs. secondary infertility: 32.8% (42 of 128) for women who had not previously been pregnant and 31.0% (18 of 58) for women who had already given birth or who had undergone an abortion.

### Spontaneous pregnancy rates by diagnostic subgroups

Endometriosis, and diminished male fertility, all significantly reduce the chances of conceiving naturally (Table 6).

**Table 6** Natural conception rates after Sensiplan training by diagnostic subgroups adjusted for age ($n = 187$ women)

| | Women with pregnancy | | Women without pregnancy | | $p$ value[a] | $p$ value[b] | Odds ratio |
|---|---|---|---|---|---|---|---|
| Endocrine reasons | 29/58 | 50% | 54/129 | 42% | 0.292 | 0.426 | 1.23 |
| Male factor | 6/58 | 10% | 38/129 | 30% | 0.021 | 0.026 | 0.38 |
| Idiopathic | 13/58 | 22% | 23/129 | 18% | 0.925 | 0.704 | 0.89 |
| Tubal factor | 11/58 | 19% | 22/129 | 17% | 0.962 | 0.510 | 0.79 |
| Endometriosis | 1/58 | 2% | 14/129 | 11% | 0.043 | 0.077 | 0.17 |
| Uterine pathology | 6/58 | 10% | 22/129 | 17% | 0.234 | 0.449 | 0.72 |
| Other | 3/58 | 5% | 19/129 | 15% | 0.153 | 0.193 | 0.46 |

[a]Log-rank test without adjustment for age

[b]Cox regression after adjustment for age in years

### Subjective assessment of the influence of the fertility awareness method on the well-being of the women

A questionnaire on the assessment of the influence of the Sensiplan method on the well-being of the participant was completed at the end of study participation ($n=171$, multiple answers possible). 78% of the participants reported that the training in identifying their fertility window positively affected their feelings towards and perceptions of their bodies. 53% reported that this knowledge had had a positive impact on their self-image as a woman. 11% of the women stated that their partnership had been negatively impacted through the observations of the fertile time. 16% of the women reported a negative effect on sexuality. Only 7% of women described the FAM method as bothersome or reported that they did not like to plan intercourse according to their fertile time. At the end of the study, 82% of patients stated that they planned to continue using the Sensiplan method or that they would use the method again if they were planning another pregnancy.

## Discussion

38% of subfertile couples (who had been trying for pregnancy since an average of 3.5 years) were successful in achieving a pregnancy after receiving training in the Sensiplan method. In those couples who had been trying to achieve a pregnancy for between 1 and 2 years, the pregnancy rate increased to 56% after 8 months following FAM training. Duration of non-conception for more than 2 years, maternal age above 35, endometriosis and male subfertility significantly reduced the chances of conceiving naturally.

### Does fertility awareness knowledge increase the spontaneous pregnancy rate in subfertile couples: more than just expectant management?

This observational cohort study lacks a control group. The intrinsic, basic, natural conception potential without fertility awareness training can be estimated, however. We consider the rate of 3% spontaneous pregnancies ($n=7$) in the cycle directly preceding study entry to be the spontaneous pregnancy rate per cycle without fertility awareness training, yielding a cumulative estimated pregnancy rate of up to 21.6% (maximum) after 8 months.

An observational study by Snick et al. on spontaneous pregnancy rates in 726 couples attempting pregnancy for 1 year showed a live birth rate of around 25% after another 12 months and 52.45% after 36 months [32], confirming computational prognostic models [33]. Our comparatively higher pregnancy rates amongst couples using Sensiplan suggest that couples benefit from training in how to identify the fertile time through self-observation.

There are three randomized controlled studies on the effect of timed intercourse in the fertile window on pregnancy rates. Robinson et al. observed 305 subfertile women with and 348 without use of a fertility monitor, which measures urine E1G and LH levels [34]. After two cycles the pregnancy rate amongst women able to identify their fertile time was significantly higher (23 vs. 14%) than amongst the controls. The second randomly controlled trial is the Oxford conception study, which has not yet published final results [35]. In a randomized trial with 143 couples with proven fertility, Stanford et al. found no significant impact of the respective FAM vs. frequent intercourse [36]. Further randomized controlled trials studying the effect of fertility awareness training with self-observation methods are needed [37].

Moreover, several probability-of-conception studies have shown that the phase of peak fertility is rather narrow (2–3 days per cycle), and that conception probabilities quickly decline even within the fertile window [11, 20, 38, 39]. This physiological fact represents a further reason for targeted intercourse.

There is already considerable evidence suggesting that awareness of the fertile window is an effective method for enhancing the probability of conception in couples starting to try for pregnancy, and is likely to be more effective than expectant management [21, 22, 25, 40]. Evers analyzed a Cochrane database of hypothetical cumulative spontaneous pregnancy rates without controlled knowledge of the time of peak fertility, reporting that the time-to-pregnancy for 20% of women who were able to become pregnant was 1 month and for 74% of that group was 6 months [31]. In comparison, 42% of women who became pregnant while using the Sensiplan method were pregnant in 1 month and 75% were pregnant within 3 months, suggesting that women conceive more rapidly with fertility awareness knowledge [22].

However, further randomized trials on FAM in subfertile couples are needed: The Cochrane review undertaken by Grimes et al. in 2004 only addressed the contraceptive effectiveness of FAMs [41]. Furthermore, it was based on three old, low-quality studies.

### Stress related to timing intercourse

As timed intercourse may cause stress, it is not recommended in several medical guidelines [5, 42]. These recommendations are based on one study only, a mail survey with 27 participants that has been criticized because of its poor quality [43]. Instead, the guidelines recommend intercourse every other day throughout the whole cycle. The impact of

the stress caused by recommending continuous intercourse throughout the whole cycle has not been investigated to date either.

The argument for withholding knowledge about the fertile time for that reason is only theoretical, since most couples in the situation of seeking to become pregnant try to detect their fertile window in some fashion, but not all methods practiced provide useful and accurate information. An Australian study that followed 282 patients seeking subfertility care from ART clinics found that 87% actively tried to improve their fertility awareness knowledge using one or more information resources, and that most believed that they had targeted sexual intercourse during their fertile window. In fact, only 13% of the participants were able to correctly identify the fertile time [43, 44]. A further study involving 80 subfertile women seeking fertility care found that 76% could not accurately identify the fertile window [45]. These results suggest that poor fertility awareness knowledge may be one of the factors preventing couples from achieving their conception potential.

In addition, as any fertility investigation and treatment may cause stress, it is up to each couple to decide the suitable way to deal with their subfertility.

### The accuracy of existing fertility awareness knowledge

While many women believe that they know when they are fertile, this has been shown to be inaccurate [43, 46, 47]. Sievert et al. interviewed 53 women who thought that they could identify their fertile window. Participants were asked to identify their fertile days over a period of 87 cycles [48]. Sievert et al. found that the women relied on the common knowledge on the fertile days which was obviously poor. They concluded that "for most women, ovulation is concealed" even if they think they know it. This supports our suggestion that women should be taught how to identify the fertile time correctly.

80% of women who were having trouble conceiving and who had attended a course led by a trained teacher of fertility awareness methods could identify the fertile time during their menstrual cycle [45]. The authors, therefore, propose that fertility awareness knowledge should be integrated into routine preconception consultations and into teaching of health professionals.

### The observation of cervical secretions: an accurate predictor of the fertile time

A considerable amount of data suggests that observation of cervical mucus changes can closely approximate the day of ovulation, is easy to learn and suitable for a large cross-section of women [2, 9, 10, 15, 18, 49]. Scarpa et al. found in a time-to-pregnancy study with 193 women that the presence of cervical secretions accurately predicts the fertile time, and that the presence of cervical secretions on the day of intercourse is a better predictor of the likelihood of conception than targeted intercourse at likely time of ovulation [38].

The ASRM guidelines state that "the fertile time is a 6-day interval that ends on the day of ovulation and correlates with the volume and character of cervical secretions." The guidelines additionally state that determining or predicting the time of ovulation may be useful for couples trying to conceive [5, 23].

Dunson et al. found that the presence of cervical secretions is an even better fertility marker than LH kits. Cervical secretions identify the whole fertile window more accurately, because they indicate more days when sexual intercourse may result in pregnancy. In their probability-of-conception analysis of a large European database of cycles, they identified that those couples with a single episode of sexual intercourse during the fertile time needed a larger number of cycles to achieve conception [50], see also [51, 52]. These findings indicate that the observation and monitoring of cervical secretions to identify the fertile time is a useful way to identify days when there is a high probability of conception if intercourse takes place.

### The psychological impact of teaching fertility awareness to subfertile couples

Klann et al. noted a positive impact on self-awareness when the FAM is used to avoid pregnancy [7]. The present study is the first one that has investigated the psychological impact of the use of the Sensiplan fertility awareness method on a population of subfertile women based on a personal assessment. The results were that 78% of women assessed the effect of the method on their own body awareness as a positive one and 53% positively rated the influence on their self-image as a woman. While a minority of couples experienced a negative effect on their relationship (11%) and sexuality (16%) when taught fertility awareness methods, this is not the case for the majority of couples.

### Providing fertility awareness as an integral part of the management of subfertility

As most pregnancies are likely to occur during the first few cycles of using the Sensiplan method, subfertile couples should be given a chance of achieving pregnancy for at least six cycles prior to any intervention. After receiving basic investigations for subfertility, couples could be encouraged to observe their fertile window to optimize their chances of achieving a pregnancy spontaneously, especially in those cases of unidentified or minor reasons for subfertility and for those women who are known to have

sufficient ovarian reserve [53–55]. According to Evers, two important questions need to be addressed before any treatment for subfertility is offered [31]: Has sufficient exposure to the chance of conception taken place? Are cost-effective, safe, and reliable treatments available?

The authors believe that the integration of fertility awareness into subfertility care is likely to lead to significant cost savings in subfertility management. Further studies on the acceptability of learning fertility awareness in the condition of subfertility are recommended.

## Conclusion

Training women to identify their fertile window in the menstrual cycle seems to be a reasonable, non-invasive and safe first-line therapy in the management of subfertility. Sensiplan is a standardized fertility awareness method that has the potential to improve spontaneous pregnancy rates in subfertile couples.

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**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest. They do not have any financial relationship with the organization that sponsored the research. They have had full control of all primary data and they agree to allow the Journal to review the data if requested.

**Ethical approval** Ethical approval was given by the Section of Natural Fertility of the German Society of Gynecological Endocrinology and Fertility Medicine at the University of Heidelberg. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki of 1964 and its later amendments.

**Informed consent** Informed consent was obtained from all individual participants included in the study. They were free to withdraw at any time.

## References

1. Raith-Paula E, Frank-Herrmann P, Freundl G, Strowitzki T (2013) Natürliche Familienplanung heute. Springer, Heidelberg ISBN 783642297830
2. Fehring RJ (2002) Accuracy of the peak day of cervical mucus as a biological marker of fertility. Contraception 66:231–235
3. Fehring RJ, Schneider M, Raviele K (2006) Variability in the phases of the menstrual cycle. J Obstet Gynecol Neonatal Nurs 35:376–384
4. Wilcox AJ, Dunson D (2000) The timing of the "fertile window" in the menstrual cycle: day specific estimates from a prospective study. BMJ 321:1259–1262
5. Practice Committee of American Society for Reproductive Medicine in collaboration with Society for Reproductive Endocrinology and Infertility (2008) Optimizing natural fertility. Fertil Steril 90:S1–S5
6. Gnoth C, Frank-Herrmann P, Freundl G, Kunert J, Godehardt E (1995) Sexual behavior of natural family planning users in Germany and its changes over time. Adv Contracept 11:173–185
7. Klann N, Frank-Herrmann P, Sottong U (1993) Auswirkungen einer natürlichen Familienplanung: Wie verändern sich Sexualverhalten und Partnerschaft? Sexualmedizin 22:384–386
8. Frank-Herrmann P, Gnoth C, Baur S, Strowitzki T, Freundl G (2005) Determination of the fertile window: reproductive competence of women—European cycle databases. Gynecol Endocrinol 20:305–312
9. Ecochard R, Boehringer H, Rabilloud M, Marret H (2001) Chronological aspects of ultrasonic, hormonal, and other indirect indices of ovulation. BJOG 108:822–829
10. Gnoth C, Frank-Herrmann P, Bremme M. et al (1996) Wie korrelieren selbstbeobachtete Zyklussymptome mit der Ovulation? [How do self-observed cycle symptoms correlate with ovulation?]. Zentralbl Gynaekol 118:650–654
11. Colombo B, Mion A, Passarin K, Scarpa B (2006) Cervical mucus symptom and daily fecundability: first results from a new database. Stat Methods Med Res 15:161–180
12. Stanford JB, Mikolajczyk RT, Lynch CD, Simonsen SE (2010) Cumulative pregnancy probabilities among couples with subfertility: effects of varying treatments. Fertil Steril 93:2175–2181
13. Frank-Herrmann P, Heil J, Gnoth C et al (2007) The effectiveness of a fertility awareness based method to avoid pregnancy in relation to a couple's sexual behaviour during the fertile time: a prospective longitudinal study. Hum Reprod 22:1310–1319
14. European Natural Family Planning Study Groups (1999) European multicenter study of natural family planning: efficacy and drop-out. Adv Contracept 15:69–83
15. Alliende ME, Cabezon C, Figueroa H, Kottmann C (2005) Cervicovaginal fluid changes to detect ovulation accurately. Am J Obstet Gynecol 193:71–75
16. Guida M, Tommaselli GA, Palomba S, Pellicano M, Moccia G, Di Carlo C (1999) Efficacy of methods for determining ovulation in a natural family planning program. Fertil Steril 72:900–904
17. Bigelow JL, Dunson DB, Stanford JB, Ecochard R, Gnoth C, Colombo B (2004) Mucus observations in the fertile window: a better predictor of conception than timing of intercourse. Hum Reprod 19:889–892
18. Stanford JB, White GL, Hatasaka H (2002) Timing intercourse to achieve pregnancy: current evidence. Obstet Gynecol 100:1333–1341
19. Dunson DB, Colombo B, Baird DD (2002) Changes with age in the level and duration of fertility in the menstrual cycle. Hum Reprod 17:1399–1403
20. Wilcox AJ, Weinberg CR, Baird DD (1995) Timing of sexual intercourse in relation to ovulation. Effects on the probability of conception, survival of the pregnancy, and sex of the baby. N Engl J Med 333:1517–1521
21. Scarpa B, Dunson DB, Giacchi E (2007) Bayesian selection of optimal rules for timing intercourse to conceive by using calendar and mucus. Fertil Steril 88:915–924
22. Gnoth C, Godehardt D, Godehardt E, Frank-Herrmann P, Freundl G (2003) Time to pregnancy: results of the German prospective study and impact on the management of infertility. Hum Reprod 18:1959–1966
23. Practice Committee of American Society for Reproductive Medicine in collaboration with Society for Reproductive Endocrinology and Infertility (2013) Optimizing natural fertility: a committee opinion. Fertil Steril 100:631–637

24. Boivin J, Bunting L, Collins JA, Nygren KG (2009) Reply: International estimates on infertility prevalence and treatment-seeking: potential need and demand for medical care. Hum Reprod 24:2380–2383
25. Herbert DL, Lucke JC, Dobson AJ (2009) Infertility, medical advice and treatment with fertility hormones and/or in vitro fertilization: a population perspective from the Australian Longitudinal Study on Women's Health. Aust N Z J Public Health 33:358–364
26. Thijssen A, Meier A, Panis K, Ombelet W (2014) Fertility Awareness-Based Methods and subfertility: a systematic review. Facts Views Vis Obgyn 6:113–123
27. Gnoth C, Godehardt E, Frank-Herrmann P, Friol K, Tigges J, Freundl G (2005) Definition and prevalence of subfertility and infertility. Hum Reprod 20:1144–1147
28. Ziller V, Heilmaier C, Kostev K (2015) Time to pregnancy in subfertile women in German gynecological practices: analysis of a representative cohort of more than 60,000 patients. Arch Gynecol Obstet 291:657–662
29. Arbeitsgruppe NFP (2011) Natürlich und sicher—das Praxisbuch. Trias, Stuttgart, ISBN9783830423645
30. Colombo B, Masarotto G (2000) Daily fecundability: First results from a new data base. Demogr Res 3:39
31. Evers JL (2002) Female subfertility. Lancet 360:151–159
32. Snick HK, Snick TS, Evers JL, Collins JA (1997) The spontaneous pregnancy prognosis in untreated subfertile couples: the Walcheren primary care study. Hum Reprod 12:1582–1588
33. Sozou PD, Hartshorne GM (2012) Time to Pregnancy: A Computational Method for Using the Duration of Non-Conception for Predicting Conception. PLoS One 7:e46544
34. Robinson JE, Wakelin M, Ellis JE (2007) Increased pregnancy rate with use of the Clearblue Easy Fertility Monitor. Fertil Steril 87:329–334
35. Pyper C, Bromhall L, Dummett S, Altman DG, Brownbill P, Murphy M (2006) The Oxford Conception Study design and recruitment experience. Paediatr Perinat Epidemiol 20(Suppl 1):51–59
36. Stanford JB, Smith KR, Varner MW (2014) Impact of instruction in the Creighton model fertility care system on time to pregnancy in couples of proven fecundity: results of a randomised trial. Paediatr Perinat Epidemiol 28:391–399
37. Manders M, McLindon L, Schulze B, Beckmann MM, Kremer JA, Farquhar C (2015) Timed intercourse for couples trying to conceive. Cochrane Database Syst Rev. doi:10.1002/14651858.CD011345.pub2
38. Scarpa B, Dunson DB, Colombo B (2006) Cervical mucus secretions on the day of intercourse: an accurate marker of highly fertile days. Eur J Obstet Gynecol Reprod Biol 125:72–78
39. Dunson DB, Baird DD, Wilcox AJ, Weinberg CR (1999) Day-specific probabilities of clinical pregnancy based on two studies with imperfect measures of ovulation. Hum Reprod 14:1835–1839
40. Evans-Hoeker E, Pritchard DA, Long DL, Herring AH, Stanford JB, Steiner AZ (2013) Cervical mucus monitoring prevalence and associated fecundability in women trying to conceive. Fertil Steril 100:1033–1038
41. Grimes DA, Gallo MF, Grigorieva V, Nanda K, Schulz KF (2004) Fertility awareness-based methods for contraception. Cochrane Database Syst Rev. doi:10.1002/14651858.CD004860.pub2
42. NICE (2004) Fertility assessment and treatment for people with fertility problems. National Institute for Health and Clinical Excellence, London
43. Hampton K, Mazza D (2009) Should spontaneous or timed intercourse guide couples trying to conceive? Hum Reprod 24:3236–3237
44. Hampton KD, Mazza D, Newton JM (2013) Fertility-awareness knowledge, attitudes, and practices of women seeking fertility assistance. J Adv Nurs 69:1076–1084
45. Blake D, Smith D, Bargiacchi A, France M, Gudex G (1997) Fertility awareness in women attending a fertility clinic. Aust N Z J Obstet Gynaecol 37:350–352
46. Hammarberg K, Zosel R, Comoy C, Robertson S, Holden C, Deeks M, Johnson L (2016) Fertility-related knowledge and information-seeking behaviour among people of reproductive age: a qualitative study. Hum Fertil (Camb) 25:1–11
47. Brosens I, Gordts S, Valkenburg M, Puttemans P, Campo R, Gordts S (2004) Investigation of the infertile couple: when is the appropriate time to explore female infertility? Hum Reprod 19:1689–1692
48. Sievert LL, Dubois CA (2005) Validating signals of ovulation: do women who think they know, really know? Am J Hum Biol 17:310–320
49. Mu Q, Fehring RJ (2014) Efficacy of achieving pregnancy with fertility-focused intercourse. MCN. Am J Matern Child Nurs 39:35–40
50. Dunson DB, Sinai I, Colombo B (2001) The relationship between cervical secretions and the daily probabilities of pregnancy: effectiveness of the two day algorithm. Hum Reprod 16:2278–2282
51. Keulers MJ, Hamilton CJ, Franx A, Evers JL, Bots RS (2007) The length of the fertile window is associated with the chance of spontaneously conceiving an ongoing pregnancy in subfertile couples. Hum Reprod 22:1652–1656
52. Stanford JB, Smith KR, Dunson DB (2003) Vulvar mucus observations and the probability of pregnancy. Obstet Gynecol 101:1285–1293
53. Gnoth C, Frank-Herrmann P, Freundl G (2002) Opinion: natural family planning and the management of infertility. Arch Gynecol Obstet 267:67–71
54. Brosens I, Brosens J (2006) Managing infertility with fertility-awareness methods. Sex Reprod Menopause 4:13–16
55. De Cicco S, Tagliaferri V, Selvaggi L et al (2016) Expectant management may reduce overtreatment in women affected by unexplained infertility confirmed by diagnostic laparoscopy. Arch Gynecol Obstet. doi:10.1007/s00404-016-4246-z