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John Billings, an Australian medical pioneer in research on fertility and contraception - At the occasion of his 100th anniversary in 1918

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REVIEW

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ABSTRACT

Background
Contemporary rankings and ratings of contraceptive options frequently neglect the Billings' ovulation method or cite inaccurate failure rates for this method.

Aims
The aim of the review is to clarify inaccurate data and to shed light on the role Billings' discoveries play in contemporary research on contraception.

Methods
Systematic analysis of the failure rates of the most widely used ratings and rankings offered by influential research institutes and government agencies.

Results
Contemporary research uses Billings' insights for stipulating new characterizations of contraceptive methods and fails to agree on estimates for these methods.

Conclusion
New data are needed to accurately assess the efficacy of the Billings' ovulation method and to determine its place in international rankings.

Key Words
Billings, contraception, family planning, birth control

What this review adds:

1. What is known about this subject?
Present knowledge is limited to Billings' original contributions to research on fertility and does not include contemporary assessments of the contraceptive methods based on his findings.

2. What new information is offered in this review?
The review offers new insight into the various ways in which the efficacy of the Billings' ovulation method is assessed internationally and suggests a taxonomic nomenclature based on historical facts.

3. What are the implications for research, policy, or practice?
The implications for research are the need for new data on the efficacy of the Billings' ovulation method and for the clinical practice an intensified availability of non-hormonal natural contraceptive methods for women who seek to avoid adverse events and risks.

Introduction

In the medical literature, the method propagated by Billings is commonly known as "Billings-Ovulation" or "cervical mucus structure" method. The following discussion examines whether the insights on which the method is based are still of any significance for contemporary approaches to contraception. For this purpose, the publications of the most esteemed scholars and the most influential organizations are analysed, compared to one another, and assessed regarding accuracy and completeness. Following the chronological order of publications, the study starts with the earliest research publications of 1986 and proceeds to the most recent ones of 2016.

Discussion

Recognition of Billings' contribution to fertility and contraception by German scholarship

As early as 1986, the most authoritative German medical reference book gave credit to Billings for his discovery.[1] It used the terminology "Billings-Ovulations-Methode" and described the method as self-observation of cervical mucus secretion for the identification of "fertile and infertile days."

In addition, it provided information on the importance of changes in cervical mucus for the cervix score, the "Zervixfaktor," and the "Konzeptionsoptimum." Cervix score is understood as a method for determining indirectly the moment of ovulation using four criteria: amount of cervical mucus, spinnbarkeit, "Farnkrautphänomen" (fern-like pattern), and width of orifice of uterus (os cervicis uteri). The "Zervixfaktor" is understood as a comprehensive designation for the cyclic changes of cervix and cervical secretion. "Konzeptionsoptimum" designates the most propitious time period for fertilization of an egg to be determined indirectly through the effect of progesterone and directly through measurement of basal body temperature or cervix diagnosis, i.e., cervix score.

In 1990, the same medical reference book provided concise information on the requirements of the Billings' ovulation method. These requirements include abstinence from unprotected intercourse from the beginning of the secretion of mucus until the evening of the 4th day following culmination of secretion.[2]

Several years later, in 2000, German medical scholarship recognized Billings as the initiator of the "Billings-Ovulation method" by underlining Billings' insight for evaluating quantitative and qualitative changes in cervical mucus during the menstrual cycle: "Die Bewertung der zyklusabhängigen quantitativen und qualitativen Veränderungen des Zervixschleims wurde erstmals 1964 von dem australischen Neurologen Billings beschrieben."[3] The authors of this study on contraceptive options presented also a ranking of methods based on the Pearl Index and assigned to the "Zervixschleimstrukturmethode" a Pearl Index of 15–25. This rating of 2000 stands incontrast to contemporary studies. German authors justify their poor rating by drawing attention to several factors that might negatively influence the efficacy of this method. Among these factors are changes in cervical mucus due to fluoride colpitis and ejaculate. As a consequence, only two thirds of women, so the claim of the authors can rely exclusively on peri-ovulatory changes of the cervical mucus as a reliable contraceptive method. Despite this unfavourable rating, German research underscores the importance of Billings' discovery for infertility treatments: "In der Sterilitätsdiagnostik wird die Beobachtung der Zervixschleimstruktur zur Bestimmung des Ovulationstermines eingesetzt."[3]

The recognition of Billings' contributions to fertility research expressed by German scholars has been confirmed by international research. International contemporary research has established the importance of all fertility awareness methods (FAM) for fecundity. Thus, a study on serodiscordant couples affirms in concluding an evidence-based research project: "FAMs provide effective, economical, and accessible options for HIV serodiscordant couples to conceive while minimizing unnecessary viral exposure."[4]

The recognition of Billings' contribution by German scholars deserves attention because such recognition is absent in other scholarly publications. Thus, the MSD Manual of 1999 fails to mention Billings' name although it refers to the cervical mucus method in the context of a discussion of periodic abstinence methods.[5] What deserves mention in this manual of 1999 is the alleged superiority of cervical mucus over basal body temperature for determining the fertile period. This superiority is confirmed also by one of the most influential research alliances, namely Contraceptive Technology.[6,7] The findings of this research have been used as a source by the U.S. Food and Drug Administration (FDA) and the World Health Organization (WHO).

Contraceptive Technology Research, FDA, and WHO

So far, the most authoritative publications on contraception have been provided by Contraceptive Technology research. Since 2011 this research has furnished scientifically sound data on the efficacy of contraceptive methods and summarized its findings in a Contaceptive Failure table (CTFailure Table).[8] This table includes methods which are based on Billings' research, namely on the evaluation of cervical mucus: "The Ovulation and TwoDay methods are based on evaluation of cervical mucus."[8] The percentages for women experiencing an unintended pregnancy during the first year of perfect use are 3.2 per cent for the Ovulation method and 3.5 per cent for the TwoDay method.[8] These percentages indicate an efficacy that is superior to female condom (perfect use of 5 per cent) and withdrawal (perfect use of 4 per cent) but inferior to male condom (perfect use of 2 per cent).[6] A ranking of the

methods rated in the CT Failure table yields the following result (Table 1):

Table 1: Ranking based on Contraceptive Technology (2011)

Method	Perfect/ typical use
Implanon	0.05/0.05
Male sterilization	0.10/0.15
Mirena (LNg)	0.2/0.2
Depo-Provera	0.2/6
NuvaRing	0.3/9
Evra Patch	0.3/9
Combined Pill and Progestin-only	0.3/9
Symptothermal method	0.4/24
ParaGard (copper T)	0.6/0.8
Male condom	2/18
Ovulation method	3/24
Withdrawal	4/22
TwoDay method	4/24
Female condom	5/21
Standard Days method	5/24

In view of the importance of changes in cervical mucus for the Ovulation and TwoDay method, one might expect also a reference to Billings who described as early as 1964 the qualitative and quantitative changes in cervical mucus around the time of ovulation.[3] Such reference, however, is missing.

What has been clarified by Contraceptive Technology, at any rate, is the perfect use estimates for those methods which rely on the evaluation of cervical mucus. These estimates are noteworthy because they are superior to some of the methods included in the widely-used survey provided by the U.S. Food and Drug Administration (FDA),[9] namely diaphragm with spermicide (perfect use estimate of 6), sponge with spermicide (perfect use estimate of 9) and cervical cap with spermicide (perfect use estimate of 26).

The fact that the FDA-survey does not mention either the Ovulation or TwoDay method is the more perplexing as the FDA acknowledges as its source precisely the research on Contraceptive Technology where these two methods are described and assessed with notable estimates, namely 3 and 4 respectively.[8] In contrast to the FDA survey, the World Health Organization (WHO)[10] acknowledges the "fertility awareness-based methods," and indicates the changes in cervical mucus as the basis for the TwoDay and Symptothermal method. The designation "Ovulation" method described by Contraceptive Technology, however, is not mentioned in the WHO table, not to speak of Billings' name as the initiator of the method.

Among research publications, a 2016 study by a renowned research institute deserves attention because it explicitly mentions Billings' name in conjunction with the cervical mucus method.[11] This study introduces a new taxonomy listing three groups of methods as belonging to the fertility awareness-based methods, namely "cervical mucus methods," "body temperature methods," and "periodic abstinence." As can be seen from the use of the plural form instead of the commonly used singular, several methods are subsumed under the denotation "Cervical mucus" -- without defining these methods and without mentioning Billings' name. In the same study, however, Billings' name appears in the context of a list of so-called "modern" methods. These modern methods are distinguished from the "traditional" methods, namely: periodic abstinence (calendar rhythm); withdrawal; Lactational Amenorrhea Method (LAM); "and other traditional lokal or folk methods."[11]

In proposing this unorthodox taxonomy, the study circumvents the classic and chronology-based classification distinguishing among calendar (after Knaus-Ogino), basal body temperature (after van de Velde), cervical mucus (after Billings), and symptothermal (after Rötzer).[3] Moreover, it fails to acknowledge the identity of "cervical mucus method" and "Billings method" by establishing a distinction between these two and listing them among the modern methods as "Mucus/Billings/Basal Body/Symptothermal method/sic!/." Clearly, in this 2016 study Billings' name is associated correctly with one of the methods, but it remains unresolved how the "Billings" method can be distinguished from the "Mucus" method.

Organizations and academic institutions

As can be seen from the above analysis, in the scholarly literature Billings' name is only rarely associated with the methods that are based on his findings, e.g., Ovulation and TwoDay method, and special discussions of his contributions are difficult to find. This is, however, not always true for information provided by some organisations as well as academic institutions. Thus, the American Congress of Obstetricians and Gynaecologists (ACOG) mentions the cervical mucus method correctly as belonging to the fertility awareness-based methods together with Standard Days method, Basal Body temperature (BBT), and symptothermal method.[12] Similarly, the U.S. Office of Population Affairs correctly mentions the Cervical Mucus Method as one of the fertility awareness-based methods

and stresses their importance also for achieving pregnancy.[13]

Among academic institutions, the Stanford University has made particular efforts to intensify research on the "Billings ovulation method",[14] and knowledge gained has been disseminated also in scholarly publications.[15] Other institutions, such as the Mayo Clinic[16] provide terminological clarifications by mentioning Billings' name and by affirming the identity of "cervical mucus method," "ovulation method," and the "Billings ovulation method." Still other publications do not mention Billings' name but at least describe the ovulation method correctly and estimate its effectiveness as 90–95 per cent, considering it equally reliable as the symptothermal method.[17]

Conclusion

In view of the foregoing analysis of research publications and information presented by various organizations, it is obvious that Billings receives only marginal recognition in renowned medical research. Although some of the modern methods, such as TwoDay and Ovulation[8] are based on his findings, no comments are made on the insights he contributed. In order to ascertain historical precision and accuracy, it must be recommended that the terminology "ovulation" or "cervical mucus" be associated with Billings' name as is dictated by principles of sound historical research. Regarding Billings' role in socio-cultural discussions on contraception and unintended pregnancies in the developing world, future studies might shed light by providing evidence-based data.

On the basis of presently available historical data, it seems justified to recognize Billings as a prominent contributor to research on contraception and fertility.[18] To what degree his discoveries were influenced by Eric Odeblad, a physician at the University of Umea in Sweden must be left to future research.[19] Given present-day knowledge there is reason to believe that without his insights all the fertility awareness-based methods would not have received the attention they receive nowadays, including the recognition by influential organizations.[12] Above all, the symptothermal method as the most efficacious of them--combining basal body temperature and ovulation-- would not have come into existence.

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