Sperm-friendly lubricant: Fact or fiction

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ABSTRACT

Objective: To assess the effects of "sperm-friendly" coital lubricants on sperm motility.

Methods: This study compared the effects of five lubricants (Optilube®, Pre-Seed®, Yes Baby®, olive oil, and egg white) on sperm motility in 60 normozoospermic semen samples obtained from men attending a private fertility clinic. Samples were exposed to each of the lubricants, with untreated samples serving as controls, and were examined microscopically at four defined time-points from 2 to 72 h after liquefaction. Sperm motility was graded according to World Health Organization criteria.

Results: With the exception of egg white, all lubricants caused significant ($P < 0.001$) reductions in sperm forward progression compared with untreated controls until 24 h after liquefaction. Furthermore, between-group comparisons of the commercially available lubricants revealed statistically significant differences in forward progression motility: Pre-Seed® was superior to Optilube® ($P < 0.001$), which in turn was superior to Yes Baby® ($P < 0.001$) at 2–4 h after exposure. Significance ($P < 0.001$) between Pre-Seed® and Yes Baby® was maintained until 24 h.

Conclusion: Although spermatozoa exposed to Pre-Seed® demonstrated greater motility than spermatozoa exposed to Yes Baby®, claims that these lubricants are sperm-friendly were refuted. Conversely, egg white was shown to be a sperm-friendly lubricant for couples who are trying to conceive.

Synopsis: Claims that so-called sperm-friendly lubricants enhance fertility were refuted, although egg white appears to be a viable option for couples trying to conceive.

KEYWORDS: coital lubricants, egg white, Optilube®, Pre-seed®, sperm motility, sperm-friendly, Yes baby®

1 INTRODUCTION

Lubrication is used by couples during sexual intercourse for numerous reasons including for dyspareunia, vaginal dryness, and enhanced sexual pleasure.[1] Dyspareunia is not uncommon. The prevalence of female sexual pain ranges from 8% to 22%,[2, 3] but may be as high as 46%. Pain during intercourse can be caused by inflammatory diseases, trauma, neurologic conditions, and alterations in hormone levels.[2] Although vaginal dryness is a common cause of dyspareunia, it is not limited to a hypo-estrogenized state.

In high-income countries, infertility may affect between 5% and 8% of couples, whereas in low- and middle-income countries it may be significantly higher at 44.2%.[4] There are numerous causes of infertility, the most common being sexually transmitted infections (including salpingitis and male genital infections),[5] smoking,[6] varicocele,[5] ectopic pregnancies,[5] obesity,[4, 7, 8] endometriosis,[9] and submucous and intramural myomas.[10] Couples with fertility issues may experience sexual dysfunction, which in turn may lead to increased lubricant use.[11]

Coital lubricants include KY-Jelly, Astroglide®, Pre-Seed®, Replens®, olive oil, and saliva.[11, 12] Egg white has also been advocated by some, specifically as a sperm-friendly lubricant for infertile couples.[13] However, conventional lubricants may be detrimental to sperm motility[14] and have been implicated in reduced fecundity.[1] This poses a unique challenge for couples who are trying to conceive but who are reliant on lubrication for sexual intercourse. Conversely, an isolated study has reported that lubrication use during intercourse does not adversely affect conception in couples who are trying to achieve a pregnancy.[15]

Currently there are several lubricants that are promoted as "sperm-friendly" and which theoretically should not affect sperm motility; published evidence backing these claims is scarce.[1] Examples include (but are not limited to) Pre-Seed® and Yes Baby®. These marketing claims require validation before endorsing their use in infertile couples. This study therefore aimed to test the sperm-friendliness of Pre-Seed®, Yes Baby®, Optilube®, olive oil, and egg white to optimize the likelihood of conception in couples who require sexual lubrication.

2 MATERIALS AND METHODS

A single blinded analytic in vitro study evaluated and compared the effects of five different lubricants on the motility of spermatozoa at successive time points.

Before conducting the experiment, institutional ethics approval was obtained from the University of Pretoria's Faculty of Health Sciences Research Ethics Committee (384/2017).

The study was performed at a private fertility clinic in Midstream, Gauteng Province, South Africa, where men aged 18 years or older, attending with their partners for infertility evaluations, were invited to participate in the study. Once written informed consent was given, semen samples were obtained by masturbation into a sterile urine container. Only those samples ($n = 60$) fulfilling the inclusion criteria (i.e., normozoospermia)[17] were used to evaluate and compare the effects of five lubricants on sperm motility. These included a volume of at least 1.5 ml semen; viscosity normal; concentration 15×10^6/ml or more; motility 32% or more progressive; and forward progression score at least 2. Semen samples that did not meet these criteria and samples from men who did not give written informed consent were excluded from the study. Semen samples were assigned a numerical code to preserve anonymity and confidentiality, and were kept in an oven at a temperature of 34–36°C.

A plastic disposable pipette was used to divide the semen equally (one to five drops) between five 5-ml Falcon tubes, each containing 0.5 ml of specified lubricant: Pre-Seed® (First Response, Church & Dwight Inc.), Yes Baby® (The Yes Yes Company Ltd.), Optilube® (Optimum Medical), olive oil, or egg white. Each tube was inverted gently several times to ensure a uniform mixture of semen and lubricant. Wet preparation slides were made as follows. An aliquot of semen was removed immediately once the semen sample was well mixed, to prevent spermatozoa settling out of suspension. A standard 10-µl volume of semen was placed on a clean glass slide and covered with a coverslip, 22 × 22 mm, providing a chamber of approximately 20 µm deep for the spermatozoa to swim freely. The sample was spread by the weight of the coverslip and care was taken to avoid the formation and trapping of air bubbles between the coverslip and the slide. The freshly made wet preparation was examined microscopically as soon as the contents stopped drifting, using a light microscope under 200× magnification (20× objective, 10× ocular) at four time points: 2–4, 24, 48, and 72 h. Raw (untreated) semen (without lubricant) served as the motility control.

Sperm movement was categorized according to WHO's *Examination and Processing of Human Semen* fifth edition.[17, 18] This simple system for grading motility distinguishes spermatozoa with progressive or non-progressive motility from those that are immotile. The motility of each spermatozoon was graded as follows: Progressive motility—spermatozoa moving actively, either linearly or in a large circle, regardless of speed; Non-progressive motility—all other patterns of motility with an absence of progression, e.g. swimming in small circles, the flagellar force hardly displacing the head, or when only a flagellar beat can be observed; and Immotility—no movement.

Each slide was evaluated for at least 100 spermatozoa in a total of at least five fields. Motility and progressive movement were recorded according to the Sperm Progression Rating System,[20] where 3 = rapid progressive motility, 2 = slow or sluggish progressive motility,1 = non progressive motility, and 0 = immotile.

Moving images were captured digitally with a Zeiss Axiovert Observer A1 inverted microscope (Zeiss) with a fitted Zeiss ERc5 Camera, allowing dynamic imaging for post hoc evaluations.

Statistical analyses for differences between groups was performed using STATA version 14 (StataCorp, College Station, TX, USA). G*Power software was used to estimate the sample size for pairwise comparisons for Wilcoxon signed rank tests.

For the determination of the required sample size, the assumption was made that the standard deviation (SD) would be 0.6 per group and that there would be five intervention groups and one control group; giving five comparisons. The assumption regarding the SD was based on the SD of observations recorded in the records of the fertility clinic. To be able to detect a difference of 0.4 with 80% power, and an α value of 0.01 the sample size was estimated at 59 per group (Bonferroni adjusted α for five comparison groups: 0.05/5 = 0.01).

Participants were recruited over a 10-month period, using complete sampling (provided they met the inclusion criteria). Recruitment continued until 60 participants had been enrolled.

3 RESULTS

A heterogeneous group of men ($n = 134$), representing all population groups in South Africa, attending a private fertility clinic were invited to participate in the study. Of these, seven declined, and 67 samples failed to meet the inclusion criteria: the semen volume was too low (<1.5 ml) in 44, the sperm count was too low (count $<15 \times 10^6$/ml) in 21, and there was evidence of decreased motility in two samples. Hence, a total of 60 semen samples from 60 participants with a mean ± SD age of 33.97 ± 5.12 years (range 20–47 years) were eligible for analysis. Baseline characteristics of these semen specimens are summarized in Table S1.

Each of the semen samples was exposed to five different lubricants as well as to a negative control. Raw (untreated) samples showed a median forward progression (FP) score of 2+ at 2–4 h after liquefaction, which declined to a score of 1 at 24 h, and then to 0 at both the 48 and 72 hour time points (Table S2, Videos S1, S2) Semen samples treated with egg white showed similar results with a median FP score of 2 at 2–4 h after liquefaction, decreasing to 1+ at 24 h and demonstrating immotility (FP score of 0) at 48 and 72 h (Table S3, Videos S3–S9).

In contrast, olive oil-treated samples fared significantly worse with an initial (2–4 h) median FP score of 1, which diminished rapidly to 0 at all subsequent analyses. (Table S4, Videos S10–S12) These attenuating effects were similar to those noted in samples exposed to the theoretically sperm-friendly lubricant Pre-Seed® (Table S5, Videos S15, S16).

Spermatozoa treated with Optilube® showed no forward progression at all the time periods evaluated, with almost 5% showing non-progressive motility at 24 h after liquefaction (Table S6, Videos S13, S14). Similarly, “sperm-friendly” Yes Baby® caused almost complete immotility at 2–4 h after treatment with no forward progression and 100% immotility from 24 h, which was sustained for the duration of the study period (Table S7, Videos S17, S18).

There were no statistically significant differences in forward progression between egg-white-exposed semen and untreated controls at 2–4 h ($P = 0.124$), 24 h ($P = 0.235$), and 48 h ($P = 0.129$). This contrasted with the statistically significant ($P < 0.001$) differences in % immotility and FP scores observed for all other lubricants compared with untreated controls at 2–4 and 24 h after liquefaction (Figure 1; Tables S8–S11, Videos S1–S7).

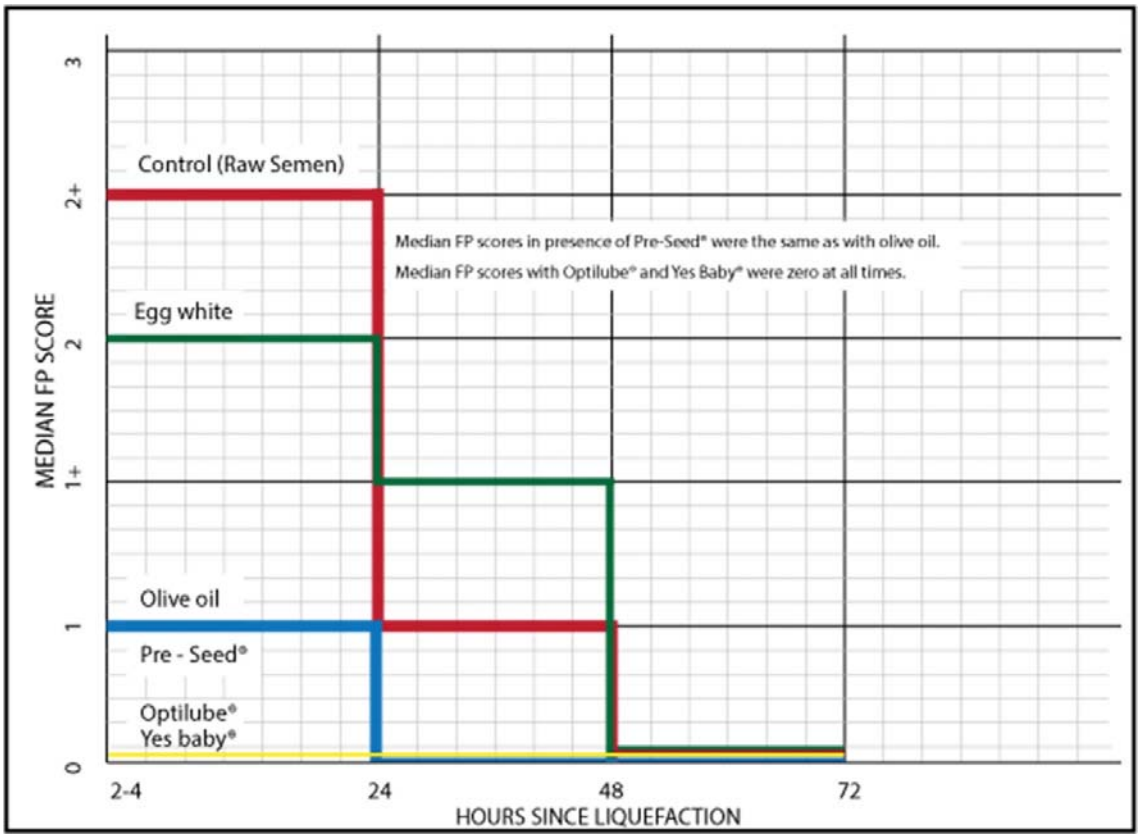

FIGURE 1. A step stair graph showing median forward progression (FP) scores for the different lubricants used to treat the semen samples ($n = 60$)

When the different groups of "sperm-friendly" lubricants were compared with each other and with Optilube® the FP scores differed significantly; spermatozoa exposed to Pre-Seed® had a greater FP score than those exposed to Optilube® ($P < 0.001$), which in turn had an FP score greater than Yes Baby® ($P < 0.001$) at 2–4 h after lubricant exposure. The significance ($P < 0.001$) between Pre-Seed® and Yes Baby® was lost at the 48-h assessment (Tables S8–S11).

4 DISCUSSION

Lubricant use in couples trying to conceive is not uncommon. Although there is limited evidence to support their claims,[16] some lubricants are marketed as sperm-friendly. Additionally, some couples may believe that lubricants enhance their probability of successful conception. This study tested these assumptions by evaluating the effects of five different lubricants on sperm motility.

Normal male fertility generally requires normal semen, which is defined by WHO as a semen volume of at least 1.5 ml, sperm counts of 15×10^6 and sperm motility greater than 32% progressive with an FP score of at least 2.[18] Sperm samples fulfilling these criteria were therefore used for this study.

Results showed unequivocally that two of the lubricants marketed as sperm-friendly were not. Compared with controls, PreSeed® and Yes Baby® caused substantial and statistically significant sperm immotility. Pre-Seed® contains propylparaben, methylparaben, sodium

hydroxide, Pluronic® (block co-polymers based on ethylene oxide and propylene oxide, which function as antifoaming agents, wetting agents, dispersants, thickeners, and emulsifiers),[19] carbomer, and arabinogalactan (biopolymer consisting of arabinose and galactose monosaccharides). Notably, parabens are used as preservatives in pharmaceuticals and it has been shown previously that propylparaben exposure decreases sperm production and efficiency in mammals.[20] In vitro studies have also demonstrated that methylparaben and propylparaben have potent spermicidal activity.[21]

Yes Baby® is paraben free, but contains numerous plant extracts, including Aloe vera, *Cyamopsis tetragonoloba*, *Ceratonia siliqua*, *Linum usitatissimum*, Xanthan gum, and *Lonicera caprifolium* (Honeysuckle) flower extract. A previous in vivo study showed that Aloe vera significantly increases spermatozoa abnormalities,[23] but it is not known if any of the other plant extracts are toxic to spermatozoa. Known plant-derived spermicides are triterpene saponins of several structural types, flavonoids, and phenol compounds. Some, such as *Sativum* extract, *Cyclamen persicum*, *Primula vulgaris*, and *Gypsophila paniculata* cause almost instant immobilization of human spermatozoa. Others including *Carica papaya* seed extract and *Echeveria gibbiflora*, have also demonstrated sperm immobilizing effects. It appears that plant spermicidal compounds primarily disrupt plasma membranes, although inhibition of sperm-specific enzymes by plant derivatives has also been reported.[22]

Although Optilube® also adversely affected sperm motility, it is not marketed as sperm-friendly, but rather as a lubricant for personal use and for medical procedures, including lubrication for gynecologic examinations. Our results also clearly demonstrated that olive oil is not a viable option for lubrication in couples trying to conceive. This concurs with a previous study.[11] Conversely, egg white demonstrated no spermicidal effects, corroborating an isolated earlier report.[13] Rather, sperm motility closely resembled the raw (untreated) semen controls at 2–4 h after liquefaction, while at 24 h the FP score was superior to that of the raw (untreated) semen control, revealing its surprising and unorthodox efficacy as a sperm-friendly lubricant. Albumin is an excellent protein source, containing well-balanced amino acids. Importantly, it lacks lipids, which may impair motility.[24]

Reactive oxygen species may be detrimental to male fertility because spermatozoa, as the result of numerous factors, are particularly susceptible to oxidative stress.[25] The addition of antioxidants such as myoinositol, melatonin, zinc, coenzyme Q10, and selenium to coital lubrication should be evaluated in future studies. It is important to note that the so called "anti-oxidant paradox" resulting from the addition of dietary antioxidants may be harmful.[26] Large doses of dietary antioxidants may acutely cause gastrointestinal upset, but of greater concern are the chronic adverse effects such as neuropathy and diabetes from selenium, sleep disturbances from melatonin, and a possible increased risk for prostate cancer from zinc.[27] Topical use of lubricants containing anti-oxidants may circumvent these pitfalls.

Observer bias was a potential limitation of this study, but was mitigated by digital capture of the microscope video material for additional blinded evaluations. In vitro studies of this nature have ethical, logistical, and scientific (repeatability, reproducibility) advantages, but may not always translate to the clinical setting. Importantly, this was one the largest studies ($n = 60$) of its kind to test whether or not certain sexual lubricants are sperm-friendly.

In conclusion, although Pre-Seed® and Yes Baby® are currently marketed as sperm-friendly, we failed to substantiate these claims. On the contrary, both agents adversely affected sperm

motility. Egg white may be a viable and much cheaper alternative for couples requiring coital lubrication while trying to conceive.

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AUTHOR CONTRIBUTIONS

JM was responsible for the study design and interpretation, and wrote the article; BG-B performed the statistical analysis; LG performed the semen analysis; and KO was the project supervisor and proofread the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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