

Ritual Immersion in a Mikveh Is Associated with Increased Risk of Group B Streptococcal Carrier State in Israeli Parturient Women

Revital Drai-Hasid^{1*}, Ronit Calderon-Margalit², Ahinoam Lev-Sagie¹, Guy Avital³,
Colin Block³, Allon E. Moses^{3#}, Drorith Hochner-Celnikier^{1#}

¹Department of Obstetrics and Gynecology, Hadassah Hebrew University Medical Centers, Jerusalem, Israel

²School of Public Health, Hadassah Hebrew University Medical Centers, Jerusalem, Israel

³Department of Clinical Microbiology and Infectious Diseases, Hadassah Hebrew University Medical Centers, Jerusalem, Israel

Email: *dhrevital@gmail.com

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Abstract

Purpose: Group B Streptococcus (GBS) infection is a major cause of neonatal sepsis. The objective of this study was to estimate the prevalence and risk factors for GBS carriage among parturient women in Jerusalem. **Methods:** A cross-sectional study of 436 parturient Jewish women at Hadassah-Hebrew University Medical Center, Mount Scopus. The study included patient interview and vaginal-rectal swab for culture. Main outcome measures were the prevalence of GBS carriage among study population. **Results:** Of the 436 participants, 77 had a positive culture for GBS, giving a carrier rate of 17.7%. No differences were found between carriers and non-carriers in age, BMI or parity. Orthodox Jewish women had a significantly higher carrier rate compared with secular Jewish women (20.6% vs. 12.8% respectively), yielding an age, education and BMI adjusted odds ratio (OR) of 1.9 (95% confidence interval (CI): 1.06 - 3.40). Similarly, ritual immersion was associated with increased risk of carrier state with an adjusted OR of 2.01 (95% CI: 1.03 - 3.92, P = 0.039). **Conclusions:** Our study suggests an association between ritual immersion in the Mikveh and GBS carriage.

Keywords

Group B Streptococcus, Carrier, Risk Factors, Colonization, Religiosity

*Corresponding author.

#Both the authors contribute equally.

1. Introduction

Invasive Group B Streptococcal (GBS) disease plays an important role in infectious illness and death during the first week of life. Clinical trials in the 1980s showed that early-onset GBS infection and disease were significantly decreased by administering prophylactic antibiotics intrapartum to patients who were colonized with GBS [1]-[3].

In 2002, the CDC, the American College of Obstetricians and Gynecologists, and the American Academy of Pediatrics issued revised guidelines that recommended the use of universal culture-based screening of all pregnant women at 35 - 37 weeks gestation to optimize the identification of GBS carriers who should receive intrapartum antibiotic prophylaxis. After the revised guidelines were issued, the annual incidence of early onset GBS disease in the US was 0.33 cases per 1000 live births in 2003-2005, 33% decline compared with 2000-2001 [3].

There are no local guidelines for the prevention of GBS disease in Israel. For many years, the GBS carrier rate among pregnant Israeli women and the incidence of neonatal early-onset invasive GBS disease were considered very low. However, according to studies of 3796 women performed in Israel between 1977 and 2006 [4]-[8], the GBS carrier rate gradually increased from 2.8% in 1977-1982 [4] to 16% in 2006 [7] (Figure 1). More importantly, this increase was accompanied with a concomitant increase in the incidence of neonatal early-onset invasive GBS disease, from 0.08 to 0.15 cases per 1000 live births in the respective years [4] [7].

In light of the increasing GBS carrier state among parturient women in Israel during the last decades, and our clinical impression that the prevalence of GBS carrier state has increased, especially among Orthodox Jewish women (those who strictly observe Jewish law) compared with secular Jewish women, we hypothesized that ritual immersion in the Mikveh might contribute to GBS carriership.

The aims of this study were therefore to estimate the GBS carrier rate among Jewish women delivering at Hadassah University Hospital, Mount Scopus (a tertiary care facility with an average of 4000 deliveries a year), to identify potential risk factors for carriership and to estimate whether ritual immersion was associated with GBS carriership.

2. Material and Methods

This cross-sectional study included a convenience sample of 436 Jewish women who were admitted for labor at

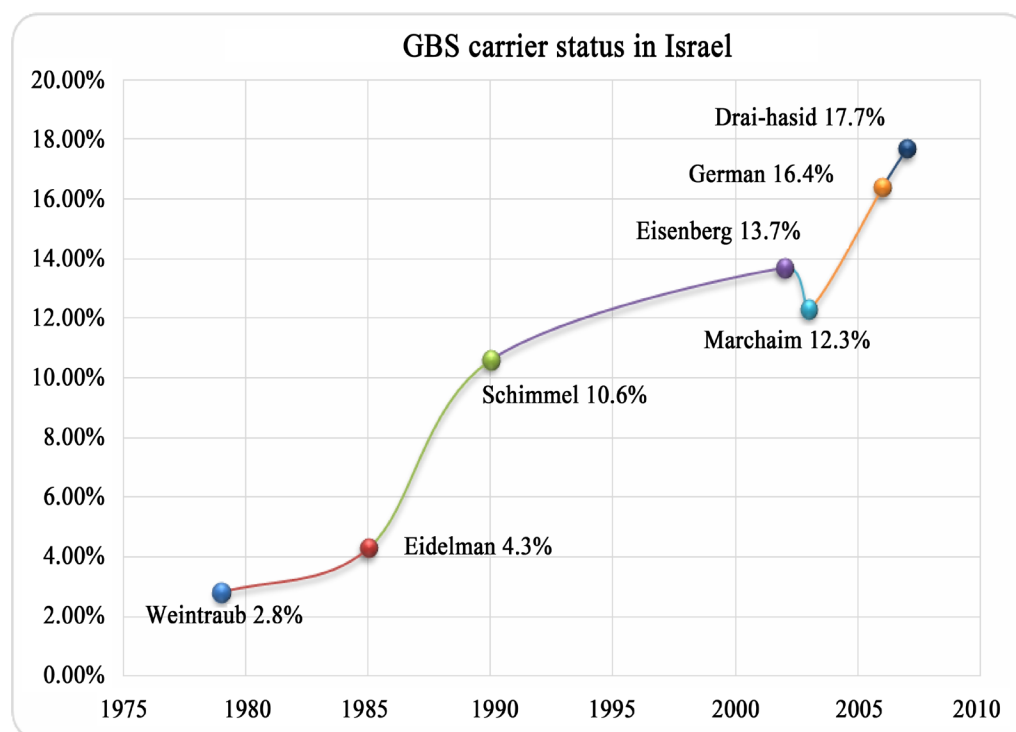


Figure 1. Prevalence of group B streptococcus carrier status in Israel by years.

the delivery room of the Hadassah University Hospital, Mount Scopus, Jerusalem, Israel between 2006 and 2009. Following informed consent, a single vagino-rectal swab was taken and sent to the hospital's microbiology laboratory for culture. Bacteria were isolated and grown on Becton Dickinson Group B Streptococcus Differential Agar (Granada Medium), a commercially available medium on which β -hemolytic strains of GBS produce orange colonies. This method is very specific and simple [9].

A structured risk factor assessment was completed by research staff with the patient either during the latent phase of labor or early postpartum. Data collected included socio-demographic information, information on religiosity, parity, gestational age at delivery, adequacy of prenatal care and number of sexual partners. The questions also referred to suspected potential risk factors for acquiring vaginal GBS, such as swimming in public swimming pools and ritual immersions in a Mikveh.

We calculated a sample size of 400 to detect a 28% exposure rate among GBS carriers and 14% exposure rate among non-carriers, assuming a 20% carriership rate with a power of 80% and alpha of 5%. The characteristics of women who were positive for GBS at the time of delivery were compared with those of GBS-negative women using chi-square for levels of education, marital status, and country of origin, high vs. non high parity and gravidity, religiosity, immersion in a Mikveh. T-tests were used for age, BMI, gestational age, parity and gravidity as continuous variables. Multivariate logistic regressions were constructed to assess the association between the study covariates and GBS carrier state, controlling for potential confounders. These analyses were performed on the SPSS statistical package (Chicago, IL) version 17. We report odds ratio (OR), 95% confidence intervals (CI) and two sided p-values.

The study protocol was approved by the Hadassah Medical Organization Institutional Review Board.

3. Results

Among the 436 women who were recruited to this study, 77 had a positive culture for GBS, yielding a carrier rate of 17.7%. None of these carriers had a neonate with early-onset invasive GBS disease; however, among the 15,675 newborns delivered during the study period three were diagnosed with neonatal early-onset invasive GBS disease, giving an incidence rate of 0.19 cases per 1000 live births. Demographic characteristics of GBS-positive versus GBS-negative participants are outlined in **Table 1**.

Orthodox Jewish women had a significantly higher carrier rate as compared with secular Jewish women (20.6% vs. 13% respectively, $P = 0.044$), yielding an age, education and BMI adjusted OR of 1.90 (95% CI: 1.06 - 3.40, $P = 0.031$). Similarly, immersion in ritual baths was associated with an adjusted OR of 2.01 (95% CI: 1.03 - 3.92, $P = 0.039$) (**Table 2**).

Among women who reported using the Mikveh, 40% (118 out of 288) immersed during pregnancy, and 52% of these women immersed in weeks 35 - 40 of gestation. No association was found between immersion during pregnancy and GBS carrier state (not shown).

We found no associations among smoking and alcohol consumption, number of sexual partners, or contraceptive use and GBS carriership. Similarly, no associations were found for the practice of stripping of membranes for labor induction, or for the incidence of urinary tract infections (UTI) either in the index pregnancy or in previous pregnancies.

4. Discussion

Our study detected a higher GBS carrier rate than previously reported in Israel. The rate of GBS carriership found in our study (17.7%) is similar to the rates reported in USA and Europe [10] [11]. In the USA colonization rate is between 10% and 30% [10]. In European countries these rates vary from less than 10% to 36% [11].

Despite these high prevalence rates, there is lack of knowledge regarding potential risk factors. Local hygiene or sexual practices can increase the risk for vaginal colonization. Other factors associated with maternal colonization include ethnicity (women of Black race), use of tampons or intrauterine devices, obesity and the absence of lactobacilli in the gastrointestinal flora [12].

The rectum is suspected to be the main reservoir for GBS in humans [10] [12]. A study that investigated risk factors for vaginal versus rectal acquisition of GBS included 1248 nonpregnant women [13]; 270 out of 1248 (21.6 percent) were colonized with GBS in either the rectum or vagina, 135 (10.8 percent) were colonized only in the rectum, and 95 (7.6 percent) were colonized only in the vagina. The study showed that sexual activity

Table 1. Demographic characteristics of Jewish laboring women with and without Group B Streptococcus.

	GBS positive N = 77	GBS negative N = 359
Age, years	29.0 ± 6.24	29.3 ± 5.6
Education		
>12 years of education, n (%)	64 (83.1%)	269 (76.2%)
Married	74 (97.4%)	351 (98.6%)
Origin Ashkenazi	49 (63.6%)	195 (55.1%)
Sepharadi	23 (29.9%)	114 (32.2%)
Mixed	5 (6.5%)	43 (12.1%)
Yemenite	0	2 (0.6%)
BMI, kg/m²	22.9 ± 6.33	22.8 ± 5.52
Weeks of gestation mean (SD)	39.5 ± 1.78	39.5 ± 1.67
Gravidity		
Mean	3.47 ± 2.97	3.22 ± 2.48
≥6	16 (21.1)	45 (12.8)
Parity		
Mean (SD)	2.84 (2.08)	2.77 (2.10)
≥6	10 (13.2)	29 (8.3)

Numbers are means ± SD or numbers (percent), as appropriate;

*Differences between study groups were not significant ($P > 0.05$) for all characteristics detailed.

Table 2. The associations of religiosity and ritual immersion in a Mikveh with Group B Streptococcus colonization according to the multivariable logistic regressions.

	P value	95% CI	Adjusted OR [*]	GBS positive n (%)	GBS negative n (%)
Religiosity					
Orthodox	0.031	1.06 - 3.40	1.9	56 (73%)	216 (60.5%)
Secular		(reference)	1	21 (27%)	141 (39.5%)
Mikveh					
Immersion in Mikveh	0.039	1.03 - 3.92	2.01	58 (79%)	230 (69%)
No immersion in Mikveh		(reference)	1	15 (21%)	104 (31%)

*Models controlled for age, education and BMI.

during the previous 4 months and the absence of hydrogen peroxide-producing vaginal *Lactobacillus* were associated with higher rates of vaginal GBS acquisition ($P < 0.05$). Sexual activity was associated with vaginal GBS colonization but not with rectal-only colonization in young nonpregnant women [13].

There is scant data regarding the risk for GBS colonization by baths or swimming pools. A small study showed that after water birth the bath water was significantly more often colonized with GBS (13/20; 65%) than after immersion followed by a delivery in bed (4/16; 25%), ($P = 0.022$) [14], supporting our hypothesis that GBS can be transmitted through immersion water.

In our study, colonization was assessed by using rectovaginal swabs. In a small ancillary study (unpublished) we performed separate rectal and vaginal swabs of women who were GBS positive in the past. Of 21 women who were carriers, 3 had only positive rectal cultures, and 10 (48%) had only positive vaginal cultures. This may support the role of ritual immersion as a source of vaginal colonization, as it is more reasonable that immersion would cause vaginal rather than rectal colonization.

Our study demonstrated associations of borderline significance among religiosity, immersion in the Mikveh, and GBS carriership. When adjusted age and BMI were factored, the associations were strengthened. However, the lack of association with immersion during pregnancy raises questions regarding the validity of this association and the timing of exposure. Nevertheless, at least one study reported that acquisition of GBS late in preg-

nancy was rare and that 90% of women who were positive at birth were positive in first trimester [15].

In Judaism, the Mikveh is a bath used for the purpose of ritual immersion, mostly after menstruation or childbirth. Customarily, before ritual immersion the women count seven blood-free days. On each of these days, the women perform internal vaginal self-examination twice daily with a white cloth for the purpose of determining the absence of uterine bleeding. Most contemporary Mikvehs are indoor constructions. All Mikvehs in Israel are subject to strict regulations by the Ministry of Health, including chlorination of the water and frequent changing of the water (daily or after every eight women). The higher carriership rate among religious women and those who immerse in the Mikveh may be related to the ritual immersion itself or may be secondary to the internal vaginal self-examinations performed in the days prior to immersion.

One of the limitations of our study is the lack of access to the Mikveh to check for the presence of GBS in the water.

Our study raises several questions. First, it is not completely understood how GBS bacteria are transmitted in women. In our study, 40% of women who regularly immersed in the Mikveh also immersed during pregnancy. It is well known that the GBS carrier state is changeable over the course of a woman's life. However, can immersion in a Mikveh before pregnancy alter the vaginal microbiota of women at delivery nine months later? The underlying mechanism by which Mikveh immersion is associated with GBS carrier state is not understood, these unresolved questions require further investigation.

In conclusion, our study suggests an association between immersion in the Mikveh and GBS colonization. Future studies are needed to either confirm or refute these findings. In light of the high rate of GBS colonization in parturients in Jerusalem, it seems advisable to consider universal GBS screening in the prenatal period for our population.

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Conflict of Interest

We declare that we have no conflict of interest.

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