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Examination of the factors relevant to the prevalence of GBS
(Group B Streptococcus) bacteria among Jewish parturients in northern Israel -
a comparison between Orthodox and secular women

ABSTRACT OF DOCTORAL THESIS

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ABSTRACT

This study is novel in combining sociological and epidemiological issues while discussing the various factors related to Group B Streptococcus carriage in pregnant women.

Research Aims: The present study sought to examine the prevalence of GBS bacteria among Jewish pregnant women in Israel and how different levels of religiosity, as well as demographics, lifestyle and clinical factors contribute to the risk of infection.

Methodology: Mixed Methods Research with explanatory sequential model.

The quantitative stage was a cross-sectional study based on the prevalence of GBS bacteria of 303 Jewish women in northern Israel who arrived at Ziv Medical Center in Safed to give birth, from December 2019 to July 2020. Women completed a self-reporting questionnaire that included sociodemographic and lifestyle information. Clinical data on women and their newborns were accessed from the medical records. In the qualitative stage, in-depth semi-structured interviews were conducted with seven mothers from different levels of religiosity as well as four functionaries from the ultra-Orthodox community, using the ZOOM platform.

Main Findings: The prevalence of GBS bacteria among Orthodox and ultra-Orthodox Jewish women was 3.4 times higher vs secular and traditional women. Adherence to the observance of the religious laws of *Niddah* by women and men positively correlated with GBS carriage. Urinary tract infection, preterm birth and higher maternal age were found to be significant risk factors for GBS carriage, while bathing in swimming pools by women and their spouses was found to be a protective factor. Education, sociodemographic status, infant birthweight and gestational age were not found to be associated with GBS carriage.

Conclusions: Observance of the *Niddah* laws were closely related to level of religiosity. For the first time, those practices were identified as risk factors that significantly increased the women's GBS infection rates. An inverse relationship between GBS carriage and bathing in swimming pools by both women and spouses, was another novel finding, since it significantly reduced the women's infection rates. As a result of strict adherence to the GBS infection prevention protocol in this study, no cases of incidence among the neonates were observed.

The practical implications: We identified for the first time, a population, previously undocumented in the literature, that is at high risk for carrying GBS and for the morbidity caused by GBS. The importance of this study was in early identification of pregnant women, particularly Orthodox and ultra-Orthodox, as GBS carriers. This can be done by universal screening of all pregnant women long before their arrival to the delivery room, with the hope of reducing the

rates of vertical transmission from mother to newborn, morbidity of mothers and newborns, and the duration of hospitalization of both after birth.

INTRODUCTION

This research examined the factors relevant to the prevalence of GBS bacteria among Jewish mothers in northern Israel according to their level of religiosity: secular, traditional, Orthodox and ultra-Orthodox.

GBS is a bacterium whose presence in the pregnant women's reproductive system can cause obstetrical complications as well as infect and endanger the health of the neonate during the birth process. This research focused on the role of sociodemographic, lifestyle, cultural and clinical factors that may be involved in the prevalence of GBS in pregnant Jewish women from northern Israel, due to their observance of the religious practices pertaining to women's monthly cycle (*Niddah*).

Gap in Knowledge - The current study aimed to clarify findings of a pilot study conducted at the Ziv Medical Center maternity department, that showed a significant and positive correlation between GBS prevalence and level of Jewish religiosity. This correlation had not been investigated, published or explained in the professional literature to date.

The main concepts

Based on the main theories of sociology, the concepts of this research are:

Sociology of religion, as religion is a key structure for understanding social life in many countries today (Dillon, 2003). Ceremonies, rituals, commandments and practices connect people and help them find belonging and meaning in the community in which they live (Turner, 1977; 1992). Two additional concepts are concerned with culture and religion - 'society is organized around pairs of binary opposites' (Levi-Strauss, [1958] 1963; Bellah, 2003, 2011; Secunda, 2012) especially the 'binary contrast between holy and unclean' (Douglas, 1966). The second concept link to the purpose and the role of the '*Niddah* ritual'- the context of female reproductive politics and its management in Judaism (Faya-Koren, 2009; Yanay & Rapoport, 2001) and to the woman's approach towards *Niddah*, and shape the way she leads her life after marriage (Cicurel & Silman, 2017) according to her level of religiosity (Klin-Oron & Ruah-Midbar, 2010; Cohen, 2010).

The epidemiological issue deals with the different prevalence rates of GBS among pregnant women worldwide (Kwatra et al., 2016; Russell et al., 2017), the risk factors and obstetric clinical syndromes related to maternal GBS carriage (ACOG, 2020) and the impact on the health of the

newborn (Verani et al., 2010; Edmond et al., 2012; Madrid et al., 2017). In addition, we discuss how to treat and prevent transmission, and morbidity and mortality from GBS (ACOG, 2020)

Research aims relating to the quantitative stage

1. To examine the prevalence rates of GBS bacteria among pregnant Jewish women in northern Israel, according to their level of religiosity.
2. To identify the sociodemographic, clinical and lifestyle factors that correlate with the prevalence of GBS bacteria in Orthodox vs. secular women.

Research aims related to the qualitative stages

1. To understand the perceptions of Jewish women and Orthodox leaders concerning adherence to the rituals of *Niddah* (purity laws pertaining to female menstruation).
2. To study the role and the importance, if at all, of the laws of *Niddah* to the Jewish woman in all levels of religiosity.
3. To uncover the benefits and challenges of adhering to the *Niddah* laws on the personal, spousal and family levels.

Research questions relating to the quantitative stage

1. What are the prevalence rates of GBS bacteria in pregnant Jewish women in northern Israel, according to their level of religiosity?
2. What sociodemographic, clinical and lifestyle factors are correlated with the prevalence of GBS bacteria in Orthodox vs. secular women?

Research questions related to the qualitative stage

1. What are the perceptions of Jewish women and the Orthodox leaders concerning adherence to the rituals of *Niddah*?
2. What is the role and the importance of the *Niddah* laws to the Jewish woman in all levels of religiosity?
3. What are the benefits and the challenges of adherence to *Niddah*, for the individual, the couple and the family?

In this study, we focused on examining the relationship between GBS carriage among females and their level of religiosity, their adherence to the religious laws of *Niddah*, other lifestyle differences and the discovery of clinical factors, only among Jewish women from the north of Israel. Women belonging to other religions or from other regions were not included in the study

since our goal was to expand on the findings obtained in the pilot study where only Jewish women residing in northern Israel were tested.

Key words: Group B Streptococcus, pregnant woman, Jewish level of religiosity, *Niddah*

CHAPTER I - THEORETICAL PRESPECTIVES

The first part presents the main theoretical foundations of the research and the main theories and key concepts emerging from this study.

I.1 Literature review of Sociology

Many studies worldwide have examined the GBS carriage rates of pregnant women as well as possible related factors, though factors related to religious Jewish lifestyle and especially the observance of various lifestyle-related commandments have not yet been examined in depth. The literature review in the current study first examines sociological theories and topics, and then considers various epidemiological aspects related to GBS carriage.

I.1.1 Sociology of religion

If we ask why religion should be studied from a sociological perspective, the answer to that would be that religion is a key structure for understanding social life in many countries today. The study of religion enables sociologists to understand the daily experiences of members of society; it also serves as a good predictor of a variety of social processes, from political action to health implications. The study of religion is a powerful source for examining a wide range of social attitudes and behaviors (Dillon, 2003). In Israel, where there is no separation of religion and state, the day-to-day conduct of Israeli residents, even if they are secular, depends heavily on religious law.

I.1.2 Belonging and meaning in the community

Since people are social creatures, ceremonies, rituals, commandments and practices help them find belonging and meaning in the community in which they live. Social life is a series of movements in space and time, including a succession of changes in pragmatic activity and a series of transitions in the situation and status of individuals and culturally recognized groups and categories. The phenomenon of rituals in different cultures is that which allows individuals to cross boundaries between social situations in various decision points in life.

The rituals provide a framework for a person undergoing life changes as he/she goes through the stages of life, such as from childhood to adulthood or from being single to being married. The religious ceremony represents the transition into the next stage of life, where the person publicly presents his/her new 'self' in order to receive social approval (Turner, 1977; Van Gennep, 1904; 1906; [1908] 1960; 1920). There are transitional ceremonies characterized by private liminality, done secretly, away from the eyes of the masses, which later on, after they have been completed, publicly present the individual's new condition in order to receive social approval. And there is liminality that is done publicly, by means of a combination of many participants, in front of a viewing audience, reflecting the symbolism of transition in different stages and rhythms of life (Turner, 1977; 1992). For example: in Judaism, weddings and bar mitzvah (for 13-year-old boys) and bat mitzvah ceremonies (for 12-year-old girls) are considered rites of passage. These ceremonies are celebrated in public and thus society gives the participants a "certificate of transition" to their new situation, from childhood to adulthood. Compared to these rituals, the ritual of *Niddah* is done privately.

I.1.3 Culture and religion

Another way to understand the management of *Niddah* in Judaism is associated with the theories of anthropologist Levi-Strauss, [1958] 1963, who claimed that society is organized around pairs of binary opposites such as: good / bad, black / white, up / down, health / sickness, and the like. Many anthropologists have taken this observation and applied it to the study of religions (Bellah, 2003, 2011; Curtis & Biran, 2001; Harrell, 1981; Secunda, 2012; Wright & D'Antonio, 1980).

One example of this is the canonical study of Mary Douglas (Douglas, 1966) who opined that analysis of lifestyles, religions, and rituals deals with the issue of **dirt and impurity**. According to Douglas, every culture and religion is based on the binary contrast between holy and unclean, but the cultural and historical context produces different content. She said that those things considered unclean and dirty in different cultures are considered **out of place/order**.

The social response to impurity directed at the woman includes prohibitions whose purpose is to protect the collective from the dangers of their blood (Ariel, 2000). The system of laws related to menstruation in Judaism consists of two elements: one, that the woman is unclean and therefore the laws of impurity apply to her; and second, the prohibition on having sexual relations with a woman marked as unclean (Ariel, 2000). In addition, women's bodily impurity provides another

reason for exclusion and preventing them from significantly participating in the public centers of power and influence of the Jewish communities (Cicurel & Silman, 2017).

I.1.4 Purpose and the role of the ‘*Niddah* ritual’

The laws of "family purity," or "laws of *Niddah*," refer to *halakhic* laws that deal with the various aspects of the marital relationship between a husband and wife (Elijah, 1998; Knohl, 2003), and especially the forbidden and permissible behavior during and after a woman's menstrual cycle. The rules are detailed, fixed, and encompass almost every aspect of married life.

In the context of female reproductive politics and its management, in Judaism, *Niddah* refers to management of a woman's monthly menstruation. At this time the woman is considered out of place / order and impure. At the end of the *Niddah* ritual the woman will return to being in order and pure (Faya-Koren, 2009; Yanay & Rapoport, 2001).

In greater detail: Once the woman has stopped seeing menstrual blood, she begins the process of purification, which includes three stages: checking for a cessation of impurity, counting seven clean days, and immersion in the *mikveh*. In the first stage, the woman must feel certain that the blood has stopped, so that she can start counting "seven clean days". The "purity test" is performed by the woman on the day she stopped seeing blood, by using a piece of soft, clean white cloth. She wraps the cloth around her finger and inserts it deep into her vagina, in a circular and thorough motion to all sides. If the cloth emerges without blood, the woman can move on to the second stage (Yosef, 2019). In the second stage after the purity test was performed, the woman counts seven clean days. Every day, she must check herself twice, morning and before sunset (in the same way she performed the purity test). After seven consecutive days in which she finds herself free of blood, the woman can immerse in the *mikveh* (Yosef, 2019). The third stage is thus the immersion in the *mikveh*. The women's *mikveh* is a pool of water sunk into the ground and reached by stairs. Proper immersion is done in a religiously-valid *mikveh* whose waters should be rainwater or spring water, that is, water that flows naturally and is not artificially pumped into the *mikveh*.

Thus, a woman's menstrual cycle, from the point of view of Jewish law, is in principle divided into two cyclical periods: days when the spouses are allowed to be in close proximity (the permitted period), and days when the spouses are forbidden to be in close proximity (prohibited period). The prohibited days are divided into the days of bleeding and the seven clean days. Thus, the total number of days of contact avoidance ranges from 11-14 days on average.

There are also *mikvehs* for men that serve as both a *mikveh* and a bathhouse with showers and a dressing area. Unlike the women's *mikvehs*, in the men's *mikvehs* the water need not be rainwater or spring water, it can be artificially pumped into the *mikveh*. As a rule, *mikveh* users are asked to bathe before entering the *mikveh*. Unlike in women's *mikvehs*, men's *mikvehs* have no privacy, the dressing areas are public, and the people shower side by side and go to the immersion pool naked (building a mikveh, from the mikveh and purity website <https://mikve.net/qna/8607/>)

I.1.5 Jewish level of religiosity

Just as the definition of identity in sociological thought is complex and elusive, so is the definition of identity of the various groups in Israeli society. The classic division - in both research and public discourse in Israel - into identity groups on a religious basis, offers four groups arranged according to a declining degree of religiousness: ultra-Orthodox, Orthodox, traditional and secular. However, these are archetypes that do not reflect the fluidity of the situation in levels of religiosity (Klin-Oron & Ruah-Midbar, 2010).

In practice, in the Israeli identity discourse, the symbolic status of the Jewish religion is maintained, due to its close connection with the ethnic nationalism, tradition and family and religious life of Jews in Israel. And although in faith and practice, their lives are not always governed by the religious establishment, Israeli Jews generally choose whichever components of the traditions they prefer to adhere. The modern world allows them to choose individually from the religion as a whole according to their own psychological, educational, cultural, and political needs (Hazah & Benjamin, 2011; Shoham, 2014). Hence, the basis for one's position on the continuum between religiosity and secularity should be personal rather than group-oriented (Cohen, 2010); research such as the present study that deals with questions of religion and religious identity and how it is reflected in everyday life and life practices, such as the '*Niddah* ritual', should be based on self-reporting of details related to level of religiosity.

I.2 Literature review of Epidemiology

I.2.1 Group B streptococcus (GBS)

Group B streptococcus (GBS) is one of the species of bacteria belonging to the family of streptococcaceae, also called streptococcus agalactiae since they cause infection in bovine udders. This bacterial group is important in the etiology of a wide variety of known and common diseases. Since GBS is gram-positive, it is sensitive to penicillin (Murray et al., 1998).

GBS is found in vaginal flora and in the gut, and is generally not associated with morbidity in healthy adults (Schuchat, 1999; Armistead et al., 2019). Pregnant women who are GBS carriers are at greater risk for preterm delivery (less than 37 weeks of gestation age) or stillbirth. They may suffer from urinary tract infection, fever (38°C and more) and prolonged rupture of the membranes (PROM) ≥18 hours. GBS carriers may also suffer from placental and amniotic fluid infection, and may infect their newborn with GBS (Schuchat, 1999; Phares et al., 2008; ACOG, 2020). Since the 1970s, the GBS bacterium has been the leading cause of neonatal morbidity and mortality, with the primary mode of infection directly from the birthing mother to the neonate (ACOG, 2020; Schuchat, 1999). GBS is usually isolated from urine, vaginal and/or rectal sites of pregnant women and from cerebrospinal fluid and/or blood of neonates (Steer et al., 2020) and analyzed by three technique methods: Xpert GBS (rapid test), qPCR (Real-time polymerase chain reaction) and culture (Vieira et al., 2019).

I.2.2 Prevalence of GBS in pregnant women

Rates of GBS prevalence in the vaginal and rectal sites of pregnant women vary among ethnic groups and geographical regions. In a meta-analysis by Kwatra et al. (2016), the prevalence rates ranged from 0.5% to 38%. The mean prevalence was 22.4% in Africa, 19.7% in the Americas, 16.7% in Eastern Mediterranean countries, 19.0% in Europe and 11.1% in Southeast Asia (Kwatra et al., 2016). The highest prevalence was found in the Caribbean nations, 34.7% (Russell et al., 2017). The worldwide pooled prevalence of maternal GBS colonization was 18% (Abbasalizadeh et al., 2021; Kwatra et al., 2016; Russell et al., 2017).

According to the Israeli National Center for Disease Control (ICDC), the overall GBS carriage rate for mothers in Israel has risen over the years, from 16% in 2010 to 22.5% in 2016 (Sefty et al., 2017). Furthermore, a review of studies conducted in Israel since 1983 (Weintraub et al., 1983) showed that GBS carriage rates in pregnant Israeli Jewish women had increased by more than 10 times by 2020 (Rottenstreich et al., 2020).

I.2.3 Maternal Complications

The main maternal complications morbidity linked with GBS exposure are:

1) Preterm Delivery (PTD) - Premature birth is defined as a birth that occurs before week 37 of pregnancy and is an indicator of the risk that the birthing mother is a GBS carrier and subsequent neonatal morbidity (ACOG, 2020; Bianchi-Jassir et al., 2017). Intrauterine infection and

chorioamnionitis are caused by the infiltration of bacteria from the vagina into the uterus and amniotic fluid, which normally constitute a sterile environment. As a result, an infection develops that can lead to preterm premature rupture of membranes and premature birth (Qiu et al., 2021). PTD is the main cause of neonate morbidity and mortality, and each week's decrease in gestation age increases the risk of morbidity in a newborn (Lin et al, 2003).

2) Premature rupture of the membranes (PROM) - PROM \geq 18 hours prior to birth is yet another risk factor for GBS-carrier birthing mothers and for neonatal morbidity, mainly in neonates 0-6 days of age (ACOG, 2020). While prolonged PROM is not limited to GBS positive women, it is 2-4 times more prevalent among GBS carriers (Lin et al,2003, Medugu et al., 2017).

3) Urinary Tract Infections (UTI) - UTI is a common bacterial infection that affects different parts of the urinary tract in women and men. It is more common in women due to the physiological and anatomical structure of their reproductive organs, and especially during pregnancy, when 14-16% of women suffer from UTI (Vasudevan, 2014). Of those 14-16%, 3.5-10% have been linked to GBS (Patras & Nizet, 2018). Therefore, the Centers for Disease Control and Prevention (CDC) have defined the bacteriuria in a pregnant woman as a risk factor associated with GBS colonization (Verani et al., 2010).

4) Intrapartum fever of more than 38°C - Another risk factor in being a GBS-carrying birthing mother is an increase in body temperature during the birth process to 38°C and higher (ACOG, 2020).

5) Stillbirth - GBS accounts for 1% of all stillbirths (the death of a fetus in uterus after 24 weeks of gestation) in developed countries and 4% in Africa, although the rate of stillbirth is not regularly monitored in most countries (Seale et al., 2017). In Israel, specifically in the city of Bnai Brak, the 2017 incidence of stillbirth linked to pregnant women infected by GBS was 0.58/1000 live births (Schnieder et al, 2020).

I.2.4 Neonatal Complications

The main route by which a newborn may be infected with GBS is by vertical transmission from a positive carrier pregnant women while passing through the birth canal or aspirating infected amniotic fluid during pregnancy (Schuchat, 1999; Vornhagen et al., 2017). In rare occasions breast milk infected with GBS can also lead to neonatal colonization (Zimmerman et al., 2017). GBS is a leading cause of neonatal morbidity and mortality, both in neonates aged 0-6 days (EOD - early-onset disease) and in infants aged 7-89 days (LOD - late-onset disease). 90% of EOD

morbidity is observed within 24-48 hours of birth and is characterized by vertical transmission by the GBS carrier mother to the newborn (Verani et al., 2010; Walker et al., 2019)

Neonatal morbidity and mortality linked with GBS exposure are:

1) Sepsis - a clinical condition in which the body's immune system mounts a systemic inflammatory response to pathogenic microorganisms in the blood, urine or respiratory system, or in the dermis or other tissues. Most neonatal sepsis occurs in the first week of neonatal life and is the leading cause of neonatal morbidity and mortality (Basu, 2015; Walker et al., 2019).

2) Meningitis - Meningitis is the second most common clinical syndrome related to neonatal morbidity and mortality (Emanchini et al., 2018; O'Sullivan et al., 2019). It is an inflammation of the soft tissues that cover the brain or spinal cord. In newborns, meningitis can cause neurodevelopmental impairment (Kohli-Lynch et al., 2017), cerebral palsy, deafness, visual impairment, cognitive disorders, hydrocephalus, epilepsy and more. 70-80% of meningial morbidity in neonates is caused by the GBS-carriage of a birthing mother.

3) Pneumonia - Pneumonia manifests as the infection of one or both lungs caused by a bacterium or virus, and results in difficulty in breathing, coughing and fever; most newborns with pneumonia are preterm, born before week 37 (Deshpande et al., 2017).

I.2.5 Incidence of GBS infection in newborns related to GBS

The incidence rates of GBS in newborns (0-89 days) vary among geographical regions: in Africa, 1.21/1000 live births; in the Americas, 0.67/1000; in Europe 0.57/1000; in the Middle East, 0.35/1000 and in Southeast Asia, 0.02/1000. The overall incidence rate for infants aged 0-89 days, was 0.53/1000 live births. The mean case fatality risk (CFR) was 9.6% (Edmond et al., 2012).

According to the Israeli National Center for Disease Control (ICDC), each year about 50 neonates develop sepsis. In 2016 the annual incidence rates were found to be 0.18/1000 live births for GBS in EOD neonates for mothers without known risk factors, 0.52/1000 live births in neonates for mothers with known risk factors (Sefty et al., 2017).

I.2.6 How to treat GBS infection

GBS is a bacterium and therefore, according to the recommendations of the CDC (Verani et al., 2010) and ACOG (2020), intrapartum antibiotic prophylaxis (IAP) is the main and the best intervention to decrease incidence of GBS infection among EOD cases (Ohlsson & Shah, 2014).

Various IAP policies are implemented today in half of the countries worldwide (Le Doare et al., 2017). IAP is given in the following cases: 1) When it is known, before the birthing process, that the mother is a GBS carrier, she will receive IAP to reduce vertical transmission during birth; or 2) If the delivery condition of the mother is not known, but one of the following risk factors is identified: preterm delivery, fever or PROM \geq 18 hours

I.2.7 How to prevent transmission, morbidity and mortality from GBS

The most effective way to prevent both morbidity of pregnant women and morbidity and mortality of newborns is through preventative care during childbirth. Implementation of screening guidelines is carried out according to two main strategies:

1) Universal Screening versus Risk-Based Screening - Vaginal-recto swab in all pregnant women between weeks 35-37 of pregnancy, has been shown to be the optimal time for early detection of GBS carriage (Verani et al., 2010), to ensure that the testing does not exceed five weeks before delivery even among women who give birth in the 41st week of pregnancy (Shabayek & Spellerberg, 2018).

2) Risk-based approach - With this approach, detection of GBS carriage in pregnant women occurs only when one or more of the following symptoms are observed: preterm delivery, fever PROM \geq 18 hours, neonate with GBS or previous neonate with GBS (Verani et al., 2010; ACOG, 2020). In Israel the screening is currently according to the presence of risk factors (Berlovitz, 2005). Nevertheless, 32% of women undergo prenatal screening for GBS, usually due either to risk factors (Waisman et al., 2019) or per their request for testing during pregnancy (Sefty et al., 2016).

I.2.8 GBS Vaccines

The development of a GBS vaccine may be an important preventive tool in reducing carriage among women and birthing mothers and preventing the infection of newborns (Verani et al., 2010). A GBS vaccine could also prevent stillbirth and preterm delivery that result from GBS maternal infection (ACOG, 2020; Steer et al., 2020). The variety of serotypes and their differing distribution in different populations, compounded with the fear of vaccinating pregnant women constitute multiple obstacles, despite the fact that vaccination may reduce morbidity worldwide, particularly in developing countries (Lin et al., 2018; Vekemans et al., 2019; Ali et al., 2020).

I.3 Conceptual Framework

Consequently, the conceptual framework of this research pertains to four interrelated areas: the values of the Jewish family that indicate their level of religiosity, and clinical, sociodemographic and lifestyle factors that correlate to the prevalence rate of GBS (Figure 1).

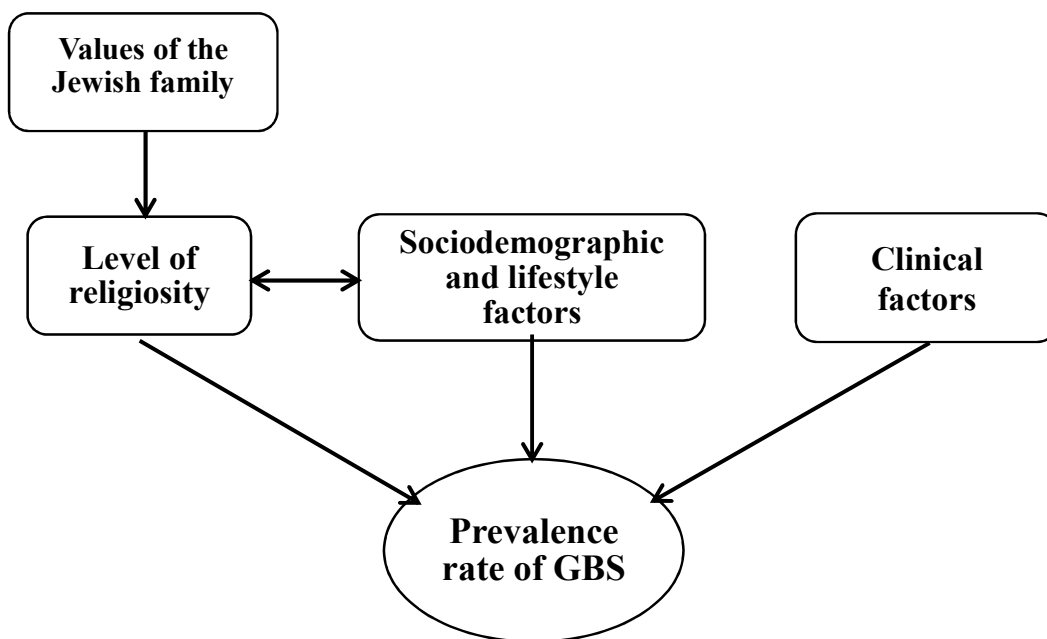


Figure 1: Conceptual framework of the research - describing the relationships between the prevalence rate of GBS and sociodemographic, lifestyle and clinical factors.

Explanation of the model

This conceptual framework model shows how the components connect to the prevalence rate of GBS (dependent variable). As mentioned before, maternal GBS carriage may impact to the health of the mother and newborn, therefore the clinical factors were included in the model. Sociodemographic and lifestyle factors are also associated with GBS carriage but are also related to level of religiosity since these factors differ between Orthodox and ultra-Orthodox women vs traditional and secular women. The observance of the commandments of Halacha and the *Niddah* ritual are part of the Jewish family values which are strongly connected to a high level of religiosity.

Ultimately, this study will, for the first time, elucidate the relationship between GBS carriers and the level of religiosity while emphasizing the *Niddah* practices as part of the Jewish

Orthodox life. The goals of this research were achieved through a mixed methods research study employing quantitative and qualitative research methods (Creswell & Plano-Clarac, 2007; Creswell & Creswell, 2018).

The next chapter presents the methodology that underpinned this research.

CHAPTER II: RESEARCH DESIGN AND METHODOLOGY

This chapter describes the methodology chosen to answer research questions.

II.1 Research aims, questions, hypotheses and variables

II.1.1 Research aims

Research aims relating to the quantitative stage

1. To examine the prevalence rates of GBS bacteria among pregnant Jewish women in northern Israel, according to their level of religiosity.
2. To identify the sociodemographic, clinical and lifestyle factors that correlate with the prevalence of GBS bacteria in Orthodox vs. secular women.

Research aims related to the qualitative stages

1. To understand the perceptions of Jewish women and Orthodox leaders concerning adherence to the rituals of *Niddah* (purity laws pertaining to female menstruation).
2. To study the role and the importance, if at all, of the laws of *Niddah* to the Jewish woman in all levels of religiosity.
3. To uncover the benefits and challenges of adhering to the *Niddah* laws on the personal, spousal and family levels.

II.1.2 Research questions

Research questions relating to the quantitative stage

1. What are the prevalence rates of GBS bacteria in pregnant Jewish women in northern Israel, according to their level of religiosity?
2. What sociodemographic, clinical and lifestyle factors are correlated with the prevalence of GBS bacteria in Orthodox vs. secular women?

Research questions related to the qualitative stage

1. What are the perceptions of Jewish women and the Orthodox leaders concerning adherence to

the rituals of *Niddah*?

2. What is the role and the importance of the *Niddah* laws to the Jewish woman in all levels of religiosity?
3. What are the benefits and the challenges of adherence to *Niddah*, for the individual, the couple and the family?

II.1.3 Research hypotheses relating to the quantitative stage

1. GBS bacteria carrier rates will be higher in Orthodox and ultra-Orthodox women than in secular women.
2. A positive relationship will be found between those who adhere to *Niddah* laws and GBS carriers.
3. An inverse relationship will be found between GBS carriage rates and maternal age, gestational age and infant weight.
4. There will be an inverse relationship between GBS carriage rates and the woman's education levels and socioeconomic status.
5. A positive relationship will be found between GBS carriage and maternal clinical risk factors.

II.1.4 Research variables

Dependent variable: GBS carrier

Independent variables: level of religiosity and adherence to *Niddah* laws, the woman's sociodemographic and lifestyle characteristics, and clinical factors for both mother and infant.

II.2 Research paradigm and model

The 'mixed methods' research tool, a combination of two research methodologies - quantitative and qualitative, was used in the present study. This integration leads to a more expansive observation that reflects the real situation. Because each method has its strength and weakness, combining the methods makes it possible to emphasize the strengths and compensate for the weaknesses of each approach (Creswell and Creswell, 2018; Tashakkori et al., 2021).

This combined study utilizes two different measurement tools - questionnaires and interviews, allowing for a more comprehensive and extensive picture of the lifestyle of birthing mothers as dictated by their secular or specific religious affiliation and the importance of this lifestyle in each woman's life.

Research model

Of the various mixed-method models, the explanatory sequential model (Creswell & Plano-Clark, 2007; Creswell & Creswell, 2018; Tashakkori et al., 2021) was chosen for this study. The model is based on two separate phases, where each one of the phases includes separate sampling and separate data analysis, thus creating, in essence, two separate studies (Creswell & Plano-Clark, 2007)

In the present study, the quantitative first phase focused on locating and examining the variables associated with the presence of GBS bacterium in birthing women, according to their level of religiosity. The qualitative second stage focused on understanding the meanings, experiences and importance of *Niddah* laws and their expression in the lives of mothers from different religious levels. The third stage examined aspects of *Niddah* conduct as explained by officials in the religious Orthodox community. The second and third qualitative stages made it possible to deepen the understanding of meaning and experience of the *Niddah* laws beyond the connections and quantitative differences obtained in the first stage (Section II.8).

II.3 Research populations

The quantitative stage is a convenience and quota sampling that consisted of 303 mothers who arrived to give birth at Ziv Medical Center in northern Israel from December 2019 to July 2020, after being tested for GBS in their HMO (Health Maintenance Organization) prior to labor onset. Convenience sampling is a non-probability sampling technique commonly used in quantitative research such as clinical research (Stratton, 2021; Etikan et al., 2016) while utilizing the quota sampling in order to recruit enough participants for the sample size calculation, relative to their proportion in the population (Guest et al., 2013; Tashakkori et al., 2021).

The interviewees were selected using a snowball sampling (Creswell & Poth, 2018; Johnson & Christensen, 2020) and represented 7 mothers from different levels of religiosity as well as 4 functionaries from the ultra-Orthodox community.

II.4 Research tools and data analysis

II.4.1 Quantitative stage

Questionnaires are the most commonly used data collection instrument. They are used in different research designs, have advantages in both audit and research, and are designed to elicit information through the written responses of subjects.

Two questionnaires were used in the quantitative section of this study:

1. Birthing Mother's self-reporting Questionnaire (Sharabi-Nov, 2019) - Socio-demographic, lifestyle and clinical information.
2. Clinical Information Collection Questionnaire (Sharabi-Nov, 2019)

Both questionnaires were analyzed statistically, using descriptive and inferential statistics.

II.4.2 Qualitative stage

Two questionnaires were used in the qualitative section of this study:

1. In-depth semi-structured interviews for the birthing mothers (Sharabi-Nov, 2021)
2. In-depth semi-structured interviews for the functionaries (Sharabi-Nov, 2021)

The rationale for using a semi-structured interview - In the present study the chosen research tool was a semi-structured interview, based on pre-prepared questions and identical for all interviewees. The order of the questions changed depending on the progress of the interview. This research tool was chosen because it is midway in the scale between a structured interview and an open interview - in a structured interview the questions are fixed and relate to relevant and known information, while in our study we wanted the interviewees to expand on their life story and share unknown and personal information to better answer the research question.

All interviews in this study were conducted during the months of March-August 2021, a period during which Israel experienced a number of Covid-19 closures. It was therefore decided to use the ZOOM platform.

Thematic and categoric analysis of the qualitative stage

The analysis in this study was based on thematic analysis (Bazeley, 2021; Bernard et al., 2016; Guest et al., 2012; Miles et al., 2020), a process of identifying and coding topics that represent participants' perceptions alongside their belief patterns. The verbal description and explanation for each category and sub-category is accompanied by representative quotes in order to increase the reliability of the findings (Guest et al., 2013).

II.5 Triangulation

Triangulation refers to using multiple sources of information, theories and strategies for learning a single phenomenon in order to increase the credibility and validity of the findings. The purpose

of triangulation is to strengthen the research as a whole and to detect topics that have not yet been well-researched, regardless of which method was the main means for data gathering (Flick, 2016; Moon, 2019; Bans-Akutey & Tiimub, 2021). In this research we used three types of triangulations: 1) **Method triangulation** (Bans-Akutey & Tiimub, 2021; Flick, 2016), 2) **Data source triangulation** (Moon, 2019) and 3) **Investigator triangulation** (Bans-Akutey & Tiimub, 2021; Moon, 2019).

II.6 Validation, Reliability and trustworthiness

II.6.1 Validation of the data in the quantitative stage

Validity is a term in research methods that symbolizes the extent to which a measurement tool actually measures that which it is intended to measure in the research, as well as the extent to which the conclusions and steps taken based on the assessment are indeed appropriate and accurate. Therefore, validity is an important component in the development and use of all measurement and evaluation tools (Creswell, J. W., & Creswell, 2018; Johnson & Christensen, 2020; Tashakkori et al., 2021).

Following are the steps and statistical tests performed in order to validate the variables and sample in the quantitative part of the study: 1) Sample representation, 2) Characteristics of Jewish birthing women who declined to participate in the study, 3) The source of GBS carrier information, 4) Validation of the level of religiosity, 5) Obstetric information / Medical file.

II.6.2 Reliability / trustworthiness of the qualitative stage

In qualitative research, research reliability is the degree to which research is deemed to be credible. That is, reliability is measured by the ability to depend on research results and trust researchers' reports (Marshall & Rossman, 2016). In order to ensure and increase the reliability or trustworthiness of the research, we explored a broad spectrum of opinions from mothers belonging to different levels of religiosity and from different functionaries in the Orthodox community, in an attempt to find repetition and common points between the responses given on similar topics, as well as hear varying descriptions of experiences from people with different levels of religiosity.

II.7 Ethical consideration

There is great importance in maintaining the rules of ethics and research morality in every study,

and in qualitative research in particular. Participants in qualitative research tend to embark on a journey of self-disclosure and it is our duty as researchers to preserve their full rights and dignity. This continuous examination of the ethical aspects throughout the entire study was based on the principles of respect, kindness and justice that form the necessary foundation for any research dealing with human beings (Marshall & Rossman, 2016). The ethics in this study are reflected throughout the entire study in the conduct and relationships with the study participants.

Both stages of the study were approved by the following ethics committees:

1. Quantitative stage - Helsinki Ethics Committee of Ziv Medical Center, #Ziv 0086-15.
2. Qualitative stage - Ethics Committee of Tel-Hai Academic College, #12/2020-18.

II. 8 Research Design according to stage of the research.

Stage	Aims	Research Tools	Research Participants	Data Analysis
1. Quantitative	1. To examine the prevalence rates of GBS bacteria among pregnant Jewish women in northern Israel, according to their level of religiosity. 2. To identify the sociodemographic, clinical and lifestyle factors that correlated with the prevalence of GBS bacteria among Jewish Orthodox vs. secular women.	1. Self-report via questionnaires 2. Data collection via questionnaires administered by the nurse	303 Jewish mothers	Independent sample t-test Chi-square Univariate and Multivariate logistic regression
2. Qualitative	1. To understand the perceptions of Jewish woman concerning adherence to the rituals of <i>Niddah</i> (purity laws surround female menstruation). 2. To study the role and the importance of the laws of <i>Niddah</i> to the Jewish woman in all levels of religiosity. 3. To uncover the personal, spousal and family benefits and challenges for those who adhere to the <i>Niddah</i> rituals	In-depth semi-structured interviews	1 secular mother 2 traditional mothers 2 Orthodox mothers 2 Ultra-Orthodox mothers	Themes and categories analysis
3. Qualitative	To understand the perceptions of functionaries concerning adherence to the rituals of <i>Niddah</i> .	In-depth semi-structured interviews	Rabbi, Ritual bath manager (<i>Balanit</i>) Bridal counselor Groom's counselor	Themes and categories analysis

The next chapter will describe the study's main findings according to the explanatory sequential model of the Mixed Methods paradigm.

CHAPTER III - RESEARCH MAIN FINDINGS

In this section, the main findings of the research are presented. The findings are presented according to the structure of the study - explanatory sequential model of the Mixed Methods paradigm; that is, first the main findings of the quantitative research and then the summary of qualitative findings.

III.1 Quantitative Findings

Research question 1: What are the prevalence rates of GBS bacteria in pregnant Jewish women in northern Israel, according to their level of religiosity?

Hypothesis 1: GBS bacteria carrier rates will be higher in Orthodox and ultra-Orthodox women than in secular women.

Overall for the maternity sample, the carrier rate for GBS was 33.7% (Table 1). In addition, a significant and direct relationship was found between maternal level of religiosity and the GBS rate, where a higher level of maternal religiosity corresponded to higher carriage rate ($p < 0.001$). In Model 1: Orthodox women are 2.5 times higher and ultra-Orthodox women are 6 times higher than secular women in GBS carriage. In Model 2: Orthodox and ultra-Orthodox mothers are 3.4 times more likely to be GBS carriers than secular and traditional mothers.



These findings confirm our main hypothesis regarding the direct relationship between the level of maternal religiosity and GBS carriage (p for trend < 0.001).

Table 1: GBS carriage rates and univariate logistic regression models for examining the relationship between GBS carriage and the level of maternal religiosity.

	Level of religiosity	GBS carriers (%)	95% CI	p
	Secular	16.9	9.1-24.7	<0.001
	Traditional	25.4	14.3-36.4	
	Orthodox/ultra-Orthodox	46.5	38.6-54.4	
	Total	33.7		
Model	Level of religiosity	OR	95% CI	p
1	Secular	Reference		
	Traditional	1.68	0.75-3.77	0.207
	Orthodox	2.47	1.14-5.34	0.022
	Ultra-Orthodox	5.97	3.00-11.85	<0.001
	P for trend			<0.001
2	Secular/Traditional	Reference		
	Orthodox/ultra-Orthodox	3.41	2.05-5.68	<0.001

Research question 2: What sociodemographic, clinical and lifestyle factors correlate with the prevalence of GBS bacteria in Orthodox vs. secular women?

Hypotheses 2: A positive relationship will be found between those who adhere to *Niddah* laws and GBS carriers.

All Orthodox and ultra-Orthodox birthing mothers, due to their level of religiosity, immerse in the *mikveh* and check for cessation of menstrual flow. Therefore, in each model, only one of these variables was included as a prediction variable for GBS carriage (Table 2, models 1-4). In Model 1, Orthodox and ultra-Orthodox mothers were 2.7 times more likely to be GBS carriers than secular and traditional mothers. In models 2 and 3 immersion in the *mikveh* was associated with a 2.6-fold increase in GBS carriage and the check for cessation of menstruation was associated with an almost 3-fold increase. Meanwhile, bathing in a swimming pool was found to be a protective factor, reducing the GBS carriage rate by about 45%. In Model 4, similar to Models 2 and 3, the ritual of checking for cessation of menstruation was associated with an almost 3.5-fold increase in GBS carriage, while bathing in a swimming pool was found in this model to be a protective factor.

In both models described in Table 3, the spouse's immersion in the ritual bath was directly and significantly associated with a 2-fold increase in maternal GBS carriage. In Model 1 it was found that the partner's bathing in a swimming pool served as a protective factor and reduced maternal GBS carriage by about 50%. In model 2, the birthing mother's bathing in the swimming pool reduced her carriage rate by about 40%, but this decrease was borderline in statistical significance.



These findings confirm our second hypothesis regarding the direct relationship between adherence to *Niddah* laws and GBS carriage.

Table 2: Multivariate logistic regression models for the correlation between GBS carriage, level of religiosity and observance of the *Niddah* commandments.

Characteristic	Values	Model 1		Model 2		Model 3		Model 4	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Level of religiosity	Secular/traditional	Ref.							
	Orthodox/ultra-Orthodox	2.73	1.49-4.97						
Use of Mikveh	No			Ref.					
	Yes			2.60	1.36-4.94				
7 clean days	No					Ref.			
	Yes					2.96	1.56-5.65		
Check menstrual Cessation	No							Ref.	
	Yes							3.43	1.80-6.52
Swimming Pool use	No	Ref.		Ref.		Ref.		Ref.	
	Yes	0.64	0.36-1.15	0.55	0.32-0.96	0.56	0.32-0.98	0.61	0.35-1.08
Urinary tract Infection	No	Ref.		Ref.		Ref.		Ref.	
	Yes	5.40	2.58-11.31	5.77	2.76-12.07	5.84	2.78-12.27	5.86	2.77-12.43
Preterm Delivery	No	Ref.		Ref.		Ref.		Ref.	
	Yes (<37 weeks)	4.65	1.17-18.48	4.97	1.24-19.88	5.50	1.33-22.70	5.51	1.32-22.98
Maternal age	Years	1.07	1.01-1.12	1.07	1.01-1.12	1.07	1.01-1.12	1.07	1.02-1.12
Neonate birth weight	gr	1.00	1.00-1.00	1.00	1.00-1.00	1.00	1.00-1.00	1.00	1.00-1.00

Table 3: Multivariate logistic regression models for the correlation between GBS carriage and spouse's use of mikveh.

Characteristic	Values	Model 1			Model 2		
		OR	95% CI	p	OR	95% CI	p
Husband/partner's use of mikveh	No	Ref.			Ref.		
	Yes	2.04	1.10-3.76	0.023	2.08	1.15-3.75	0.016
Husband/partner's swimming pool use	No	Ref.					
	Yes	0.52	0.29-0.94	0.030			
Mother's use of swimming pool	No				Ref.		
	Yes				0.59	0.33-1.04	0.067
Urinary tract Infection	No	Ref.			Ref.		
	Yes	5.66	2.66-12.03	<0.001	5.84	2.77-12.32	<0.001
Preterm Delivery	No	Ref.			Ref.		
	Yes (<37 weeks)	4.37	1.36-21.22	0.016	4.77	1.21-18.79	0.025
Maternal age	Years	1.07	1.02-1.13	0.011	1.06	1.01-1.12	0.027
Neonate birth weight	gr	1.00	1.00-1.00	0.205	1.00	1.00-1.00	0.279

Hypotheses 5: A positive relationship will be found between GBS carriage and maternal clinical risk factors.

In all four models urinary tract infection was found to indicate a significant risk marker directly associated with GBS carriage, by 5.4 times to almost 5.9 times. Another risk marker was preterm birth. Among GBS carriers, the incidence of preterm birth was 4.65 to 5.5 times higher than in non-carriers (Table 2).



These findings confirm our fifth hypothesis regarding the direct relationship between maternal clinical risk factors and GBS carriers.

III.2 Qualitative Findings

The system of themes and categories

As a result of coding the interviews, a cohesive system of themes and categories was gradually created that maintained a hierarchy of 2-3 levels. At the top of the hierarchy four central themes were identified with 2-5 categories (Table 4). The following is a general description of the four main themes:

1. Halacha - This theme deals with the description of the first stage of acquaintance with Halachic laws related to *Niddah*, the manner in which these laws are learned and their effect on the woman at her level of religiosity.

2. Observance of the commandments of *Niddah* - This theme includes a description of the practices that must be performed by the wife and husband during the *Niddah* period and the guidance they receive from community functionaries, all in accordance with the couple's level of religiosity.

3. The couple and the family during the *Niddah* period - This theme includes a description of the effect of the *Niddah* period on the entire family according to its level of religiosity, both in terms of changes in the life of the couple and in their behavior towards the children at different ages.

4. Benefits and challenges of the *Niddah* period - This theme discusses the benefits and challenges arising from the preparation and maintenance of various aspects of the *Niddah* laws - personal, marital and family coping, all dependent on the couple's level of religiosity.

Table 4: Themes, categories and sub-categories emerging from the interviews.

Themes	Categories	Sub-categories
1. Halacha	1. The stage of getting to know the Halachic laws related to <i>Niddah</i>	
	2. Self-revelation	
	3. Preparation	
	4. Learning	
2. Observance of the commandment of <i>Niddah</i>	1. Abstaining from physical touch	
	2. Immersion in the mikveh (ritual bath) - women	
	3. Immersion in the mikveh (ritual bath) – men	
	4. Observance of <i>Shivah NeKiim</i> (7 additional days of abstinence from sexual relations after validated end of menstruation) / <i>Niddah</i>	
	5. Guidance and approval of actions	
3. Couplehood and family during <i>Niddah</i>	1. Enhancing the couple's conversation	
	2. Mutual excitement and courtship	
	3. The process of change in a couple's relationship	
	4. Behavior towards children	
4. Benefits and challenges of the <i>Niddah</i> period	1. Benefits	1. Time for caring for oneself
		2. Medical benefits
		3. How the <i>Niddah</i> period affects the husband
		4. The influence of <i>Niddah</i> on the next generation
	2. Challenges	1. Arguments between the husband and wife
		2. Lengthening of the <i>Niddah</i> period
		3. Embarrassment and invasiveness
		4. OCD and Halachic sterility
		5. Aesthetics and cleanliness

CHAPTER IV - CONCLUSIONS

This chapter presents the conclusions of this research study, specifying the factual and conceptual conclusions emerging from the results, as well as practical implications. It also includes the strengths and limitations of the research, the contribution of the research to knowledge and practical recommendations for further research.

IV.1 Factual conclusions

The main purpose of this study was to expose the link between GBS rates and the level of religiosity of Jewish women in northern Israel.

A factual conclusion that emerged from this study is the direct link between GBS carriage and level of religiosity: the more religious a woman is, the more likely she is to be a carrier. The main factors explaining this relationship are differences in the woman's lifestyles and not differences in sociodemographic factors or education level. Level of religiosity, and in particular adherence to the *Niddah* laws was naturally strongest among Orthodox and ultra-Orthodox women; although the monthly *Niddah* period presents significant difficulties and challenges for both spouses, they do not question its purpose or their own dedication to preserving its laws. In fact, they find spiritual, physical and marital meaning in that monthly challenge.

This study demonstrates for the first time that each of the *Niddah* components on its own (the vaginal check for cessation of bleeding that continues for seven days and immersion in the *mikveh*), as well as the spouse's immersion in the *mikveh* were found to be significant risk factors for the woman's GBS carriage. That is, without their knowledge, women observing the *Niddah* laws are infected with GBS at a significantly higher rate than those who do not observe the *Niddah* laws.

Bathing in a swimming pool, however, offers a certain extent of protection against GBS infection for both men and women, regardless of level of religiosity. This, too, is a novel finding in the literature. Another conclusion that emerged from the clinical research findings is that GBS carriage is linked to increased rates of preterm birth and UTI but not to fever in the birthing mother (38°C and more) or PROM ≥ 18 hours.

IV.2 Conceptual conclusions

On the conceptual level, this study links different lifestyle metrics to GBS-carriage rates of pregnant women. This study is novel in its use of an evidence-based model to explain how GBS

rates are related to various components of the religious Jewish lifestyle by providing an accurate profile of an at-risk population and focusing on risk factors and their distribution.

Sociological concepts

The current study showed evidence of an interaction between GBS carriage rates and level of religiosity. All the models tested indicate that each of the *Niddah* laws is a risk factor in itself, and that the sociological-behavioral component that has been shown to have a role too significant to be considered an accidental risk factor.

Clinical concepts

It is impossible to compose a profile of a ‘normal’ woman since each woman has an array of different lifestyle components. Therefore, a differential view is necessary regarding the understanding and identification of risk factors for GBS carriage that were not known until now, related to GBS carriage in pregnancy in general, and for Jewish women in particular.

First, advancing personalized medicine must be promoted; the results of this study present a challenge to ob-gyn physicians as well as to the Israeli Ministry of Health to raise its awareness to the risk factors and dangers of GBS infection in pregnant women. Second, legislative change must be promoted, both for routine identification of female GBS carriers as well as for strictly monitoring water quality and hygiene in ritual baths.

IV.3 Practical implications emerging from the research results

The practical implications of the study relate primarily to public health recommendations:

1. Identifying the population at risk for GBS that was unknown to date
2. Changing policy to perform universal screening instead of screening according to risk factors in order to prevent the mother’s GBS carriage and the newborn’s infection.
3. Promoting regulations together with close and practical supervision of hygienic care in all *mikvehs* for both women and men.
4. Developing a program for officials and functionaries in the Orthodox and ultra-Orthodox community (rabbis, *mikveh* supervisors, bridal counselors) with information about the connection between *Niddah* and GBS carriage, in order to promote a prevention program to reduce infection, while still preserving the Orthodox and ultra-Orthodox lifestyle.
5. Promoting a GBS-prevention program among physicians who do post-partum follow-up, both in the HMOs and in hospitals, informing them of the study findings and how to try and prevent at-risk women from becoming GBS carriers.

IV.4 Research strengths

The empirical results reported here should be examined in light of some strengths.

1. **Sample representativeness** - No significant differences were found in either the age of the mothers or in the distribution of place of residence between the mothers in the study sample and all the mothers during that period

Dependent variable - GBS carriage was tested in the HMO and the results were validated in three different ways when the women arrived to give birth.

Level of Jewish religiosity and other variables - The level of religiosity variable as reported by the mother was validated by a number of queries: observance of various *mitzvot* (commandments) related to daily life, observance of the *Niddah* laws before pregnancy and testimonies that emerged during the interviews.

Conducting the interviews - In order to create a respectful interview and to incorporate an understanding of the concepts and manner of discourse practiced among the Orthodox and the ultra-Orthodox interviewees, all the interviews were conducted by an ultra-Orthodox woman who specializes in conducting interviews and transcribing.

IV.5 Research limitations

This study also had some limitations that must be mentioned, despite attempts to reduce them.

The study population

1) The maternity population at Ziv Medical Center in Safed does not reflect the general population of Israel. 2) For economic and practical reasons, and despite the fact that the sample was found to be representative, it should be noted that this study included only women who came to give birth with a known result, either positive or negative, of a GBS carrier test.

Research tools - Since this is the first study of its kind in Israel or worldwide, no suitable questionnaire existed to examine the correlation between level of Jewish religiosity and the practices of the *Niddah* laws and the prevalence of GBS. Therefore, it was impossible to compare the findings of the current study with similar studies.

Qualitative research - In the qualitative research only the women's voices were heard. The benefits and challenges pertaining to the relationship between the spouses during the *Niddah* period were presented in this study from the perspective of women only.

IV.6 Original Contribution to knowledge

To the best of our knowledge, the current study opens the first window to the association between the prevalence of GBS and level of Jewish religiosity, focusing on the adherence to *Niddah* laws.

IV.6.1 Contribution to theoretical knowledge

Bridging the gap in knowledge - For the first time, a positive relationship was found between woman's level of religiosity and her risk for GBS carriage.

At-risk population – This study identified a unique population of women who are at risk for carrying GBS, a population that was previously unknown in the literature but is now in the spotlight.

The practice of *Niddah* - The factors related to the *Niddah* practice allow us not only to link the level of religiosity to GBS carriage, but also to examine the specific components and to what extent each of them raises a woman's chances of becoming a carrier.

Bathing in swimming pools - Bathing in a swimming pool, for both of the woman and her spouse, was a protective factor against the woman's GBS infection.

IV.6.2 Contribution to practical knowledge

The findings of this study are closely related to the issue of public health.

On a practical level, the findings of this study may form the basis for changing the existing policy in Israel regarding the testing of women for GBS, currently carried out only for pregnant women with risk factors. A new policy proposed to routinely perform universal screening will identify pregnant women with GBS even if they are asymptomatic, and treat them with IAP to prevent neonatal infection during the childbirth process. Should the policy of testing women for GBS not change as this study suggests, then locating at-risk populations must be at the forefront for medical policymakers and community physicians so that they may refer pregnant women for GBS testing before they give birth.

The women's and men's *mikvehs* are a significant risk factor for GBS carriage in women. It is our duty to bring this novel and important finding to the attention of the relevant people (for example: officials in the ultra-Orthodox community, local authorities, the Ministry of Health) in order to establish appropriate regulations to improve water quality and hygiene and, equally important, to monitor them consistently. Immersion in the mikveh is an integral part of the *Niddah* rituals, required monthly for every Orthodox and ultra-Orthodox woman. Therefore, hygienic

regulation should be considered a practical plan for maintaining the health of women by preventing GBS infection, and in particular the health of pregnant women.

IV.6.3 Contribution to methodological knowledge

This is the first study of its kind in Israel and, in fact, worldwide, so that no suitable questionnaires (quantitative and qualitative) existed to examine the correlation between the prevalence of GBS and sociodemographic, clinical and lifestyle factors with a focus on the practices of the *Niddah* laws.

IV.7 Further research study

With the results of this study and the need to establish an understanding the risk factors surrounding the *Niddah* laws for Jewish women regarding GBS carriage, we recommend further research:

1. This study's population consisted only of Jewish women from northern Israel; therefore, other studies should examine GBS rates of pregnant women in other Orthodox and ultra-Orthodox communities in Israel and in other religious Jewish communities throughout the world.
2. Further research can examine GBS rates in women who immerse in *mikvehs* where the quality of the water is closely monitored, similar to the monitoring carried out in swimming pools. Such a study would confirm or refute the connection found in this study.
3. Examine directly, with the help of questionnaires and interviews, the effect of the *Niddah* period on the partner and not indirectly through the woman's point of view.

IV.8 The importance of the research

IV.8.1 The importance of the research to the Israeli Jewish woman

The importance of this study was in the early detection of GBS carriage in pregnant women, especially Orthodox and ultra-Orthodox, and their follow-up until delivery. As a result, in this study all women who were GBS carriers were treated, according to the protocol, with IAP, thus preventing neonatal infection. Therefore, the incidence rate of neonatal GBS infection in this study was 0/1000 live births. In Israel, GBS testing in pregnant women is performed only according to the presence of risk factors. However, after having been presented the findings of this study, the Israel Society of Obstetrics and Gynecology now intends to re-examine the possibility of universal screening in all women at 35-37 weeks of pregnancy, Jewish and non-Jewish, at the HMO before

arrival to the delivery room. This should reduce the rates of infection from mother to newborn, neonatal morbidity and duration of hospitalization of mother and newborn after birth.

IV.8.2 The universal importance of the research

Pregnant women throughout the world are GBS carriers, although at different infection rates. In many countries around the world, and especially in developed countries, there are diverse Jewish communities where some lead an Orthodox or ultra-Orthodox way of life. Those women who perform the *Niddah* practices are as prone to GBS carriage as women in Israel, and for them it is very important to be screened before giving birth.

Furthermore, a number of studies, mostly from Africa, have found that women who perform a cleansing / rinsing or vaginal examination similar to a purity test, are at increased risk for carrying GBS. These women, too, need to be tested for GBS carriage to prevent maternal morbidity and neonatal infection, especially in countries that do not have proper medical infrastructure to treat severe neonatal morbidity and especially neonates with low birth weight.

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