

Male Infertility and Consanguinity in Lebanon: The Power of Ethnographic Epidemiology

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This problem changed my mind, my life, my prayers. I asked God, "Don't leave me to be like this, never to have children." It broke my life. I want to have my own children too much.

An infertile Lebanese man

Introduction

Infertility, classically defined as the inability to conceive after a year or more of trying and resulting in involuntary childlessness, is a problem of global proportions, affecting more than 80 million individuals of reproductive age worldwide (Vayena, Rowe, and Griffin 2002). Recent estimates suggest that 14% to 17% of all couples may be unable to conceive at some point in their reproductive lives (Campbell and Irvine 2000; Fishel, Dowell, and Thornton 2000). In some societies, however—particularly those in the "infertility belt" of central and southern Africa—as many as one-third of all couples are infertile (Bentley and Mascie-Taylor 2000; Boerma and Mgalla 2001; Larsen 1994, 2000; Vayena et al. 2002). Factors causing high rates of infertility in parts of the non-Western world are varied. Tubal infertility due to sexually transmitted infections and postpartum, postabortive, and iatrogenic infections, as well as pelvic tuberculosis and pelvic schistosomiasis, is widely regarded as the primary form of preventable infertility in the world today (Sciarra 1994, 1997; Vayena et al. 2002). As noted in a recent World Health Organization report, tubal blockage is responsible for about two-thirds of all cases of infertility among women in sub-Saharan Africa, and about one-third of all cases of infertility among women in the developing world (Vayena et al. 2002). Prevention

of reproductive tract infections (RTIs) is therefore imperative, especially in the context of scarce health resources to overcome infertility in most non-Western countries (Inhorn 2003a; Sundby 2002; Vayena et al. 2002).

Male Infertility

Not all infertility is preventable. Male infertility is a neglected reproductive health problem, yet it contributes to at least half of all cases of subfertility worldwide (Chan 2007; Kim 2001). Male infertility is often "idiopathic," or of unknown cause; hence, it is recalcitrant to prevention, and is among the most difficult forms of infertility to treat (Carrell, De Jonge, and Lamb 2006; Devroey, Vandervorst, Nagy, and Van Steirteghem 1998; Irvine 1998; Kamischke and Nieschlag 1998). So-called male factors in infertility include low sperm count (oligospermia), poor sperm motility (asthenospermia), defects of sperm morphology (teratozoospermia), and total absence of sperm in the ejaculate (azoospermia), the latter sometimes due to infection-induced obstructions of the epididymis.

Male infertility is a health and social problem that remains deeply hidden, even in the West. Studies have shown male infertility to be among the most stigmatizing of all male health conditions (Becker 2000, 2002; Cannon, Glover, and Abel 2004; Greil 1991; Inhorn 2004; Lloyd 1996; Upton 2002). Such stigmatization is clearly related to issues of sexuality. Male infertility is popularly, although usually mistakenly, conflated with impotency, as both disrupt a man's ability to impregnate a woman and to prove one's virility, paternity, and manhood (Inhorn 2002, 2003a, 2003b, 2004; Upton 2002; Webb and Daniluk 1999). Although little is known about the experience of male infertility worldwide, scattered reports from Egypt, Israel, and Botswana show that male infertility, like female infertility, has profound effects on personhood, marriage, and community relations, particularly in pronatalist settings where all adults are expected to marry and produce offspring (Carmeli and Birenbaum-Carmeli 1994, 2000; Inhorn 2002, 2003b, 2004; Upton 2002). Thus, male infertility is often a cause of profound human suffering, particularly in high-fertility societies where all men are expected to father offspring. For this reason alone, it is a global reproductive health problem of considerable significance.

The New Genetics of Male Infertility and Consanguinity

Unfortunately, in at least 45% of men with abnormal sperm production, a well-defined cause cannot be established (Chan 2007; Maduro and Lamb 2002). However, because of advances in the field of genetics, it is now realized that a significant percentage of male infertility cases, particularly those that are severe, are due to genetic abnormalities. Indeed, "a virtual explosion

in the identification of genes affecting spermatogenesis has occurred" in recent years (Maduro and Lamb 2002: 2197). A variety of abnormalities in both the Y and X chromosomes, as well as genetic abnormalities of the hypothalamic-pituitary-gonadal axis involved in the production of reproductive hormones, are now well-established causes of male infertility (Maduro and Lamb 2002; Maduro, Lo, Chuang, and Lamb 2003).

Probably the most frequent molecular genetic cause of infertility in men involves microdeletions of the long arm of the Y chromosome, which are associated with spermatogenic failure (Chan 2007; Krausz, Forti, and McElreavey 2003). In men with such deletions, these genetic alterations are incurable and will be present throughout a man's lifetime (Baccetti et al. 2001). Such deletions are manifest in a variety of sperm defects, including defects of the sperm head (e.g., round heads, heads with craters) and sperm tail (e.g., stunted, immotile, or detached tails) (Baccetti et al. 2001).

A growing literature suggests that such genetic sperm defects cluster in families, for example, among sterile brothers, and may be linked to ancestral consanguinity. Consanguinity (known as "cousin marriage" in popular parlance) is usually defined as the intermarriage of two individuals who have at least one ancestor in common, the ancestor being no more distant than a great-great grandparent. The progeny of such consanguineous marriages are usually referred to as inbred (Gunaid, Hummad, and Tamim 2004). Recent studies by Baccetti et al. (2001) and Latini and colleagues in Italy (2004) suggest that consanguinity is highly correlated with rare genetic sperm defects. These include a range of syndromes that impact sperm morphology (shape) and motility (movement) and may be transmissible to the male offspring. Consequently, male infertility may be heritable, and may cluster in families and communities, depending upon the level of consanguineous marriages in the general population.

Consanguinity in the Middle East

Within the Middle East, the rates of consanguineous marriages are quite high, ranging from 16% to 78%. For example, the following rates of consanguineous marriages have been recently reported across the Middle Eastern region: Algeria, 36.4%; Bahrain, 32%; Egypt, 29% to 39%; Iran, 23% to 78%; Jordan, 51.3%; Kuwait, 35% to 54.3%; Lebanon—29.6% for Muslims and 16.5% for Christians; Libya, 46.5%; Mauritania, 60.1%; Oman, 54%; Qatar, 46%; Saudi Arabia, 54% to 57%; Sudan, 65%; Syria, 38%; Tunisia, 40.2%; Turkey, 21.2%; and United Arab Emirates, 50% to 54%. Between 8% and 30% of these marriages are first-cousin marriages, the closest form. For example, first-cousin marriage rates have been recorded for a number of Middle Eastern countries as follows: Egypt, 11.4%; Jordan, 32%; Kuwait, 26% to 30.2%; Lebanon—17.3%

among Muslims and 7.9% among Christians; Oman, 34%; Saudi Arabia 31.4% to 41.4%; United Arab Emirates, 30%; and Yemen, 32%. Furthermore, in several of these countries, rates of first-cousin marriages are increasing (e.g., Yemen, United Arab Emirates), while the rates are either stable (e.g., Oman) or declining (e.g., Jordan, Lebanon, Kuwait, Syria) in other Middle Eastern countries where media may have played a role in discouraging cousin unions (Al-Gazali et al. 1997; Gunaïd et al. 2004; Hamamy, Jamhawi, Al-Darawsheh, and Ajlouni 2005; Jurdi and Saxena 2003; Saadat, Ansari-Lari, and Farhud 2004; Abbasi-Shavazi, McDonald, and Hosseini-Chavoshi [in press]; Sueyoshi and Ohtsuka 2003).

According to a recent overview of mutation research, Mediterranean, and Muslim Mediterranean populations in particular, rank highest in the world in terms of increased frequency of congenital malformations and recessive disorders linked to consanguinity (Birenbaum-Carmeli 2004). Indeed, as shown in the seminal volume on *Genetic Disorders among Arab Populations* (Teebi and Farag 1996), Arab populations have high frequencies of autosomal recessive disorders, homozygosity of autosomal and X-linked traits, and a plethora of new genetic syndromes and variants, the majority of them autosomal recessive. In clinical settings in the Arab world, consanguinity manifests itself in congenital malformations, mental retardation, blindness and deafness, sickle cell anemia and thalassemia, cystic fibrosis, congenital hydrocephalus, Down syndrome, and specific metabolic diseases (Rajab and Patton 2000; Zlotogora 1997). Recent studies have also linked consanguinity to a range of poor child health outcomes, including neonatal diabetes mellitus, low birth weight, and apnea (cessation of breathing) associated with prematurity (Mumtaz et al. 2007; Tamim, Khogali, Beydoun, Melki, and Yunis 2003).

Although consanguinity has never been definitively linked to male infertility in the Middle East, it is striking to observe that male infertility cases are highly prevalent in Middle Eastern infertility clinics, often making up between 60% and 90% of the patient caseload in in vitro fertilization (IVF) centers (Inhorn 2004). In addition, many infertile Middle Eastern men present with severe oligo-, astheno-, and teratozoospermia, as well as azoospermia of non-obstructive origin. It is widely speculated within the Middle Eastern assisted reproductive community that these severe forms of male infertility are attributable to genetic causes. However, with the exception of Kuwait (Alkhalaf, Verghese, and Mhuarib 2002; Mohammed et al. 2007), genetic studies of male infertility have yet to emerge from the Middle Eastern region. To our knowledge, no studies have attempted to examine the association between male infertility and consanguineous marriage practices.

To that end, this chapter presents a novel attempt to determine whether consanguinity is related to male infertility in the Middle Eastern nation of Lebanon. We conducted a study that combined epidemiological and ethnographic approaches to the study of male infertility, in the hopes of shedding

light on this troubling male reproductive health condition. We argue that "ethnographic epidemiology," involving a case-control research design and mixed-methods approach, is a powerful means to achieve understanding of a variety of important public health problems. In the next section, we briefly describe what we mean by this concept, before turning our attention to the study, its methodology, and results.

The Power of Ethnographic Epidemiology

In recent years, anthropologists have pointed to the overlapping nature of anthropological and epidemiological interests and have sung the praises of collaborative research, especially that focusing on the health consequences of human behavior (Dunn and Janes 1986; Fleck and Ianni 1958; Hahn 1995; Inhorn 1995; Inhorn and Buss 1994; Trostle 2005; True 1996). Books have been written on the need for interdisciplinary, anthropological-epidemiological approaches to the study of health and disease (Janes, Stall, and Gifford 1986; Trostle 2005). Sessions at national meetings have been devoted to this theme, and editorials in major journals have deemed the "integration of epidemiological and ethnographic research methods" to be necessary for the continued maturation of the field of medical anthropology (Brown 1992). Nevertheless, as noted by Trostle (1986a, 1986b, 2005), the history of such collaboration has been one of "benign neglect" and "missed opportunities," and some observers have even pointed to an active "schism" or "divergences" between the anthropological and epidemiological communities (Inhorn 1995; Rubinstein and Perloff 1986).

Nonetheless, as highlighted in Trostle's (2005) recent book on *Epidemiology and Culture*, a new field of "cultural epidemiology" is emerging, one that focuses attention on culturally defined categories of disease classification, meaning, risk, and behavior; in addition to the more commonly employed "social variables," such as income, marital status, and occupation (Trostle 2005). Trostle urges the integration of both qualitative (textual) and quantitative (statistical) methods to improve the understanding of disease problems. He provides many relevant examples of "productive collaboration" between the disciplines of anthropology and epidemiology, with regard to health problems such as epilepsy, cholera, and adolescent smoking.

Like Trostle, we argue that anthropology and epidemiology "need each other." Epidemiology, as a methodologically exacting discipline, is devoted to the discovery of disease prevalence and incidence rates and to the statistical assessment of causal associations between risk factors and disease outcomes in human populations. However, what epidemiology possesses in terms of methodological rigor, it often lacks in contextual understanding of *why* certain human groups

are at risk of problems such as infertility at particular historical moments, in specific places, and within particular political, economic, legal, and religious contexts (Turshen 1984). This lack of contextual understanding has led one critic to point to epidemiology's methodological "*rigor mortis*" (Nations 1986). Ultimately, epidemiology needs to understand and utilize anthropology's ethnographic methods and forms of qualitative data analysis to understand the range of possible culture-specific behavioral patterns requiring assessment as disease risk factors. Once these risk factors are assessed, anthropology can help to explain why such culturally embedded risk practices persist and may be resistant to change for sociocultural and political-economic reasons.

Anthropology also needs to understand and utilize epidemiological methods and forms of quantitative data analysis. Through ethnography, anthropologists are able to identify myriad, potentially health-demoting environmental risk factors and behavioral practices. Yet, to assess *which* of the many factors identified through ethnographic research place people, usually unwittingly, at risk of problems such as infertility, a formal epidemiological approach to risk assessment is also necessary.

Methodologically, anthropology and epidemiology converge in more ways than one. The vast majority of epidemiological studies are "observational" (Kelsey, Thompson, and Evans 1986), just as anthropological studies are "participant observational." In fact, perhaps the most common method of data collection employed in epidemiology is the same one that is employed in anthropology, that is, talking with people. Epidemiologists gather data through communicating with research subjects, just as medical anthropologists do. Although the interviewing techniques of epidemiology tend to be more formal than those of anthropology, since they rely on standardized interview schedules, they nevertheless may be quite in-depth.

If anthropology and epidemiology do differ methodologically, the difference may be one of scope rather than kind. Anthropologists tend to have a greater variety of methods to choose from than do epidemiologists, and are much less concerned than most epidemiologists in establishing normative methodological standards (Rubinstein and Perloff 1986). However, all of the methods used by epidemiologists, including interviewing, archival research, and record review, are also components of the anthropological tool kit. Conversely, epidemiologists tend to deal with larger sample sizes than do anthropologists and to work with people who do not view themselves as necessarily connected in any way (Dunn and Janes 1986). Yet, some epidemiological studies, especially those in genetic epidemiology, may work with very small sample sizes of individuals who are often related. Thus, there are no fixed rules that divide the epidemiological and anthropological enterprises on a methodological basis, and it could be argued that their similarities are perhaps greater than their differences (Hahn 1995; Inhorn 1995).

Within anthropology, a movement is afoot to examine the ethnographic enterprise itself, in terms of both methodological rigor and reflexivity. Recent calls to reassess the ethnographic toolkit have pointed to the improved validity achieved by using multiple, or "mixed" methods in one study, rather than relying on the ethnographic standbys of participant observation and/or interviews with key informants (Bernard 2005). The use of multiple methods is considered to be one form of *triangulation*, a term referring to the process of cross-checking data that is being used within the social sciences, including anthropology (Fetterman 1998).

It is no wonder, then, that more and more medical anthropologists have begun to conduct synthetic ethnographic-epidemiological studies, in which both ethnographic and epidemiological research designs, methods of data collection and analysis, and interpretive insights are employed in order to understand more clearly the factors underlying a variety of public health problems. This is particularly true of those who have received training in both disciplines (including the first author of this chapter and several other authors in this volume). For example, in Inhorn's earlier study of male infertility in Egypt (Inhorn 1994; Inhorn and Buss 1994), both ethnographic and epidemiological approaches were employed, showing that the culturally embedded practice of male water pipe smoking increased the risk of male infertility outcomes.

Unfortunately, few other integrative studies of this kind have been conducted in the Middle East. Nonetheless, the literature on the potential health effects of consanguinity in the Middle East is burgeoning¹ because of the high prevalence of both consanguinity and genetic disorders across the region, as well as concerns over the need to initiate culturally sensitive genetic counseling programs (Al-Gazali 2005; Panter-Brick 1991; Raz, Atar, Rodnay, Shohan-Vardi, and Carmi 2003).

Given this background, our goal in this study was to assess whether consanguinity is a possible risk factor for male infertility in Lebanon, whether Lebanese men are concerned about this possibility, and why the practice of consanguineous marriage is socially and culturally supported. To that end, an ethnographic-epidemiological study was undertaken in Lebanon in 2003 to determine possible risk factors for male infertility, including men's own causal assessments of their male infertility problems (Inhorn 2004). Male infertility clearly troubles Lebanese men, who, in their concerted attempts to overcome the problem, pose the question, "Why me?" Although men rarely link consanguinity directly to their infertility problems, they are concerned that male infertility may "run in the family." As our study will show, these men are probably right: Male infertility *does* cluster within families, particularly families characterized by intergenerational patterns of consanguinity. Thus, consanguinity may be linked to male infertility in Lebanon, even though the rates of consanguinity in that country are the lowest in the region.

In this chapter, we will describe the research setting and methodology, present the results of our epidemiological research on consanguinity and male infertility, and then provide an ethnographic analysis of why consanguinity is a deeply embedded cultural practice in Lebanon as elsewhere in the Middle East. We include two case studies of infertile Lebanese men who are deeply troubled by their infertility and the family and child health problems that have ensued. In the end, we suggest that consanguinity, male infertility, and genetic disorders are understudied public health issues that deserve increased attention. We believe that anthropologists working in public health are ideally situated to address these problems, given anthropology's long history of research on cousin marriages cross-culturally (Carsten 2004; Dumont and Parkin 2006; Fox 1984; Holy 1996; Westermarck 2003), as well as the recent anthropological interest in new forms of genetic testing (Finkler 2000; Franklin and Roberts 2006).

Research Setting and Methods

Lebanon (population, 4.3 million) is a small, Middle Eastern nation on the Eastern Mediterranean, bordered by Israel on the South and Syria on the North and East. Lebanon is the most religiously diverse nation in the Middle East, with 18 officially recognized religious sects. Unfortunately, inter-sectarian tensions and ongoing disputes with both Israel and Syria have plunged Lebanon into more than 30 years of ceaseless violence, including a 15-year civil war (1975–1990), numerous political assassinations, and a summer war between Israel and Lebanon's Hizbullah in 2006. Thus, this war-torn country has experienced considerable death and destruction. Not surprisingly, many infertile Lebanese men who lived through the war years attribute their reproductive health problems to *il harb*, "the war" (Inhorn 2004), which is a likely risk factor for male infertility in the country (Kobeissi et al. in press).

This study was conducted in 2003, a relatively "quiet" year, despite the initiation of the U.S.-led war in Iraq, which led to several acts of violence against American and British interests in Lebanon. During 2003, the first author (Inhorn) joined with a group of six Lebanese physicians (Abu-Musa, Awwad, Fakihi, Hannoun, Lakkis, Nassar) to undertake a combined ethnographic-epidemiological study of male infertility in the capital city, Beirut. The study, supported by the National Science Foundation and the U.S. Department of Education Fulbright-Hays Faculty Abroad Program, was designed to accomplish both epidemiological and ethnographic goals. On the epidemiological side, the study attempted to assess a number of behavioral and environmental risk factors for male infertility in Lebanon, including the effects of the Lebanese civil war. On the ethnographic side, the study attempted to assess Lebanese men's subjective experiences of male infertility, which were

characterized in the ethnographic study design as consisting of "four M's": masculinity, marriage, morality, and medical treatment-seeking.

To accomplish both these epidemiological and ethnographic goals, a classic epidemiological case-control study design was utilized, drawing upon the infertile patient populations in two of the busiest and most successful IVF clinics in central Beirut. One of these was located in a large, private university-based teaching hospital, the American University of Beirut Medical Center (AUBMC), and catered to a religiously mixed patient population of both Sunni and Shia Muslims, Christians of various sects, Druze (a minority Muslim sect), and various immigrant and refugee populations, including Palestinian refugees living in Lebanon. The other clinic, FIRST IVF, was a private, stand-alone center catering primarily to southern Lebanese Shia patients, but also to Christian and Sunni Muslim patients coming from both Lebanon and neighboring Syria.

Between these two clinics, 220 married men, who had been unable to conceive a child with their wives during at least the 12 months before the study, were recruited as research subjects by the physicians and the AUBMC IVF unit head nurse (Hammoud). The patients were divided into two groups according to their fertility status based on their semen analyses. The cases included 120 men who were considered infertile because of repeated abnormal semen analyses. The control group included 100 men with repeated normal semen analyses, but who were seeking fertility treatment because of female factor infertility, including tubal, polycystic ovary syndrome (PCOS), unexplained, or endometriosis-related infertility. Subjects underwent semen analysis at the time of the study, generally on the day of study recruitment at the IVF center to confirm the results of previous analyses. Semen analysis was reliable and standardized to reflect current World Health Organization guidelines (World Health Organization 1999). Semen analysis results were important to this study, as they clearly distinguished infertile cases from fertile controls. This epidemiological case-control design also served important ethnographic purposes; it allowed the anthropologist leading the study to understand the experiences and perspectives of infertile men, as well as men who were not infertile but who were experiencing childless marriages.

Following informed consent, interviews were conducted by the anthropologist with all of the men in the study. The interviews took place in a private room in the clinics, where the study was explained and assurances of confidentiality were reiterated through both verbal and written informed consent. About half of the interviews were conducted in Arabic and half in English, depending on the preference and ability of informants (many of whom were well educated and spoke excellent English). Although tape-recording was presented as an option on the informed consent form, most of the men were uncomfortable with being tape-recorded, declining this option.² In most cases,

the anthropologist conducted interviews alone, but a research assistant was present during some of the Arabic interviews, especially in the initial stages of the research when the first author was learning a new and distinct dialect of Levantine Arabic.

A large amount of data was collected during an 8-month study period (January–June 2003), given that multiple epidemiological and ethnographic methods were utilized. Reproductive history and epidemiological semi-structured interviews were used to collect baseline information on demographics (age, religion, place of residence, education, income) and reproductive and sexual history (age at first sexual intercourse, number of sexual partners, age at marriage, number of marriages, pregnancies and births). Detailed questions were asked about consanguineous marriage practices between spouses (first cousin, second cousin, distant relative), between the research subject's parents (i.e. first-degree consanguinity) and grandparents (i.e., second-degree consanguinity, of maternal or paternal relatives or both). In addition, questions were posed about other known cases of male infertility in the immediate family (i.e., brothers, cousins, uncles, fathers). Other reproductive risk factors were also assessed through the semi-structured interview, including various reproductive illnesses, presence of chronic diseases, lifestyle factors (especially tobacco and caffeine consumption), and occupational and war exposures. As noted earlier, this epidemiological data collection strategy was coupled with laboratory-based semen analysis, generally carried out at the time of the reproductive interview in the clinic-based IVF laboratories. In addition, more than 200 men in the study agreed to have blood samples drawn for the purposes of later toxic metal analysis at the University of Michigan (Inhorn et al. 2008).

The ethnographic portion of the study consisted of both in-depth, open-ended interviews and participant observation in the clinics. Once the reproductive history and epidemiological interviews were completed, most of the men in the study agreed to speak about their lives more generally, and, in some cases, wives joined these discussions. These interviews focused on men's experiences of male infertility and the "four M's" (masculinity, marriage, morality, medical treatment-seeking) and generated 1200 pages of qualitative interview transcripts, which were then coded and analyzed for salient themes. Case study reports were also written immediately after each interview, to summarize the stories and topics that men chose to discuss with the anthropologist.

In addition, the anthropologist conducted both formal and informal interviews with staff at both clinics, including physicians, nurses, and embryologists. Participant observation and conversations held in clinic waiting areas, laboratories, and doctors' offices were recorded in detailed field notes, 550 pages of which were also coded and later analyzed.

The epidemiological data were also coded and entered by one of the authors (Kobeissi), a Lebanese graduate of both American University of Beirut and University of Michigan (UM), who analyzed the data for her doctoral thesis at UM's School of Public Health. Data were analyzed using the Statistical Package for Social Sciences (SPSS Version 12). Univariate analysis consisted of frequency and percentage distributions for the different categorical variables in the study. Means, standard deviations, and ranges were computed for the different continuous variables, with checking for normality and outliers.

Bivariate analysis mainly utilized Chi-Square-Fisher's exact test to test the association between the main outcome variable (male infertility) and the various exposure and confounding variables. The purpose of this analysis was to examine crude associations and to check for potential confounders and effect modification.

Multivariate analysis involved a backward logistic regression model, where analysis included the different exposure and confounding variables that yielded significant results during bivariate analysis. Odds ratios, *P*-values, and confidence intervals were computed at a type I error (α) of 5%. The final model incorporated the exposure and confounding variables that displayed the most significant odds ratios.

The Epidemiology of Consanguinity

As shown in Table 6.1, there were no significant differences between cases and controls in terms of sociodemographic background. The average age in both groups was 39, and most subjects had completed high school. The average monthly income in both groups was around US\$ 1800. The majority of cases and controls resided in Beirut (46% versus 35%, respectively). The religious backgrounds of cases and controls were comparably heterogeneous; approximately one-quarter of the cases and controls were Christians and three-quarters were Muslims. Controls were slightly more likely to be white-collar professionals; however, the professional background of both groups was relatively similar. Reflecting Lebanon's high educational levels, around 60% of cases and controls held professional sector jobs, including as physicians, engineers, professors, and businessmen.

As shown in Table 6.2, 16% of cases and 24% of controls reported consanguineous marriage to a related spouse, a difference that was not statistically significant. The cases were more likely than controls to report first-degree (parental) and second-degree (grandparental) consanguinity; but the difference (46% cases versus 37% controls) was also not statistically significant. The socioeconomic and educational backgrounds did not differ significantly between

Table 6.1. Distribution of Sociodemographic Factors among Cases and Controls

VARIABLES	MALE INFERTILITY STATUS	
	CASES ^a	CONTROLS ^b
Age (y), mean (SD)	38.5 (6.6)	39.4 (6.1)
	P-value = .901	
Years of education (y), mean (SD)	13.7 (4.2)	14.2 (5.5)
	P-value = .606	
Salary (US\$ monthly), mean (SD)	1768 (2500)	1829 (2130)
	P-value = .541	
Current residence, n (%)		
Beirut	43 (35.8)	45 (45.0)
South Lebanon	25 (20.8)	8 (8.0)
Mount Lebanon	16 (13.3)	8 (8.0)
Elsewhere in Lebanon	12 (10.0)	10 (10.0)
Outside Lebanon	24 (20.0)	29 (29.0)
	P-value = .034	
Religion, n (%)		
Christian	32 (26.7)	27 (27.0)
Muslim	84 (70.0)	68 (68.0)
Druze (Muslim sect)	4 (3.3)	5 (5.0)
	P-value = .721	
Profession, n (%)		
Blue collar	17 (14.2)	6 (6.0)
Clerical	18 (15.0)	22 (22.0)
Business/teaching	40 (33.3)	40 (40.0)
Doctor/lawyer/diplomat/professor	31 (25.8)	26 (26.0)
Government employee	14 (11.7)	6 (6.0)
	P-value = .151	

^a Cases are those in whom infertility is present.^b Controls are those in whom infertility is absent.

those who reported first- and second-degree consanguinity in the parental and grandparental generations and those in the study who did not report such consanguineous backgrounds. Both groups were equally likely to have married a related wife (i.e., paternal or maternal cousin), suggesting that consanguineous marriage practices in Lebanon are continuing over the generations.

As shown in Table 6.3, those who reported first- or second-degree consanguinity (or both) were more likely to be Muslims or Druze (83%) than

Table 6.2. Bivariate Analysis of Consanguinity among Cases and Controls

VARIABLES	MALE INFERTILITY	
	CASES N (%)	CONTROLS N (%)
Consanguineous marriage to wife		
Wife is a relative (maternal or paternal cousin)	19 (15.8)	24 (24.0)
Wife is not a relative	101 (84.2)	73 (73.0)
Relationship unknown	0 (0)	3 (3.0)
	P-value = .102	
Type of consanguineous marriage		
Wife: maternal cousin	8 (6.7)	16 (16)
Wife: paternal cousin	10 (8.3)	7 (7)
Wife: both paternal and maternal cousin	1 (0.8)	1 (1)
Wife: unspecified cousin	3 (2.5)	0 (0)
Wife is not related	98 (81.6)	76 (76)
	P-value = .107	
Consanguineous marriage between parents and/or grandparents		
None are related	64 (53.4)	60 (60.0)
Parents or grandparents are related	34 (28.3)	29 (28.0)
Both parents and grandparents are related	22 (18.3)	8 (8.0)
Relationship unknown	0 (0)	3 (3.0)
	P-value = .113	
Reported male infertility problems in immediate family		
Yes	52 (42.6)	14 (14.0)
None	68 (57.4)	85 (85.0)
Unknown	0 (0)	1 (1)
	P-value < .001	

Christians (17%). Reflecting intersectorian socioeconomic differences, they also had lower average monthly reported incomes (US\$ 1723) than those who did not report consanguineous backgrounds (US\$ 1925). As noted above, cases were more likely than controls to report first- or second-degree consanguinity or both (46% versus 37%), suggesting that infertility in men may be the product of consanguineous marriage practices in previous generations. However, this difference was not found to be statistically significant, as shown in Table 6.2.

Table 6.3. Distribution of Socioeconomic Background by Consanguinity Status

VARIABLES	FIRST OR SECOND CONSANGUINITY STATUS	
	PRESENT	ABSENT
Age at marriage (y), mean (SD)	32.1 (6.1)	32.4 (6.8)
	P-value = .725	
Wife's age at marriage (y), mean (SD)	26.3 (5.5)	26.8 (6.3)
	P-value = .577	
Years of education (y), mean (SD)	14.2 (5.6)	13.8 (4.1)
	P-value = .384	
Monthly salary (US\$), mean (SD)	1723 (1847)	1925 (2921)
	P-value = .539	
Kinship to wife, n (%)		
Wife related	21 (50.0)	21 (50)
Wife not related	68 (39.3)	105 (39.3)
	P-value = .207	
Religion, n (%)		
Christian	18 (17.3)	6 (6.6)
Druze	2 (1.9)	6 (6.6)
Muslim	84 (80.8)	67 (73.6)
	P-value = .207	

However, a clear family clustering of male infertility cases was detected in this study. Controlling for other risk factors, the odds of reported infertility problems among immediate family members, particularly brothers, male cousins, uncles, and, in some cases, fathers, was 2.58 times as high among cases as in controls ($P < 0.057$), as shown in the multivariate logistic regression analysis in Table 6.4.

In addition, when only azoospermic and severely oligospermic men (<1 million sperm/mL³) were separated from the rest of the male infertility cases, the consanguinity and family clustering effects were amplified. Exactly 50% of these infertile men reported first- and/or second-degree consanguinity, and nearly 40% reported known male infertility problems among close male relatives, as shown in Table 6.5. In other words, half of the most severely infertile Lebanese men in this study came from consanguineous families.

Table 6.4. Multivariate Logistic Regression Analysis of Consanguinity and Family Clustering of Male Infertility

VARIABLE	ADJUSTED ODDS RATIO	P-VALUE (95% CI)
Male infertility problems in immediate family (yes/no)	2.58	0.057 (0.971-6.8)
Consanguineous marriage between parents and/or grandparents (yes/no)	0.865	0.756 (0.34-2.17)

Table 6.5. Consanguinity and Family Clustering of Male Infertility among Men with Severe Oligospermia and Azoospermia

VARIABLES	MEN WITH SEVERE OLIGOSPERMIA AND AZOOSPERMIA	
	N	%
Distribution of first- or second-degree consanguinity		
None	33	50.8
First or second degree	19	29.2
Both First and second degree	13	20.0
Distribution of infertility problems in immediate family		
None	38	58.5
Male factor	25	38.4
Female factor	2	3.1

Male infertility clustered among the men in these families, suggesting a strong genetic component to their sperm defects.

To summarize, although first- and second-degree consanguinity did not prove to be significantly associated with male infertility outcomes overall, two findings of this study are of possible significance. First, male infertility clearly clustered in families among cases in this study; nearly 40% of these men could identify other known cases of male infertility in the immediate family, particularly among brothers, first cousins, uncles, and, in some cases, fathers. Second, among the "most infertile" subset of Lebanese men in this study—those with either azoospermia or severe oligospermia—half were the offspring of consanguineous unions among the parental or grandparental generations (or both). These findings suggest a genetic predisposition to male infertility in Lebanon.

Clearly, more epidemiological work needs to be done to ascertain the underlying mechanisms of genetic male infertility, including whether consanguinity

can lead to the propagation of male infertility among future generations (Al Abdulkareem and Ballal 1998; Al-Gazali et al. 1997). Moreover, molecular genetic testing to search for Y chromosome microdeletions is also necessary, and represents one of the major limitations of our own study. However, because of the availability of standardized semen analysis, objective evidence of azoospermia and severe oligospermia was provided in this study, allowing us to determine frequencies of consanguinity and family clustering of male infertility cases among the most severely affected infertile men. Furthermore, the quality of the measures in this study was high, because of the use of multiple validation techniques (i.e., in-depth reproductive history and risk factor interviews, coupled with the results of semen analysis). Semen analysis of both cases and controls was possible in this study, because of the recruitment of infertility clinic-based research subjects; clinic-based research samples are common in infertility studies, despite the potential for selection bias when fertile controls are not drawn from the general population. No major problems existed in terms of adjusting for missing and nonresponse data, and the size of the sample approximated required statistical "power." Although the study relied on self-report of consanguinity and infertility among family members, research subjects usually had no difficulty providing this information. Some men even volunteered to sketch their family genealogy, marking the relevant infertility cases at the time of the interview.

The Ethnography of Consanguinity

Given these epidemiological findings, two major questions of anthropological interest may be posed. *Why* do men marry their cousins in Lebanon and other parts of the Middle East? And, do men recognize that consanguinity may be a risk factor for male infertility in the region? It is important to begin with some context—namely, consanguineous marriage is a socially supported institution throughout much of the non-Western world, not only the Middle East. For example, in the primarily Hindu states of South India, marriages between close relatives occur in 20% to 45% of all cases, with uncle-niece and first-cousin marriages, usually mother's brother's daughter (MBD), the preferred form (Bittles, Manson, Green, and Rao 1991; Bittles, Grant, Sullivan, and Hussain 2002). Before World War II, MBD first-cousin marriages were also quite common among the Han of China, who make up about 90% of the total population. Similarly, Buddhists, Christians, Jews, Parsees, and Druze living in Asian countries frequently marry their kin. Anthropological and ethnographic surveys have also reported cousin marriage rates of 35% to 50% across sub-Saharan Africa (Bittles et al. 1991, 2002). Although contemporary Westerners have been prohibited religiously and legally from entering into consanguineous

marriages, particularly with first cousins, it should be noted that (1) 0.5% of North Americans and Western Europeans are reported to marry their cousins (Bittles et al. 1991), and (2) legal statutes in many U.S. states disallow first-cousin marriages but allow consanguineous unions with other relatives of varying degrees (Ottenheimer 1996).

Consanguinity receives particularly strong expression in the various regions of the Muslim world, including North and Sub-Saharan Africa, the Middle East, and Central, South, and Southeast Asia (Hussain and Bittles 1999, 2004). Among the world religions, consanguineous marriage finds its highest level of support within Islam, with the Prophet Muhammad having married his daughter Fatima to his first-cousin Ali. In Middle Eastern Muslim societies, first-cousin marriages—especially patrilineal parallel, that is, father's brother's daughter (FBD) marriages (*bint 'amm*)—are the preferred form (a preference that is unique to the Middle East), with partners having at least one set of grandparents in common, and sometimes two (Bittles et al. 1991; Eickelman 2001). In the Muslim world, 20% to 55% of all marital unions are consanguineous, with even higher rates (>75%) in some regions of the Middle East (Abbasi-Shavazi et al. in press).

Why are consanguineous marriages so commonly practiced in the contemporary Muslim Middle East? A wide range of deeply rooted historical, sociocultural, economic, and religious rationales support consanguinity in these societies. It is often believed that consanguineous marriages offer a range of social and economic advantages, including better compatibility between husband and wife and their respective families (who are known to each other rather than being "strangers," often within the context of arranged marriages); maintenance of wealth, property, and inheritance within the family; superior prenuptial negotiations vis a vis reduced bridewealth payments; reinforcement of familial and tribal affiliations; strengthened affective ties between the relatives who marry their children to each other; and fewer of the complications and uncertainties inherent in marriages with nonrelatives (Bittles et al. 1991; El-Hazmi et al. 1995; Gunaid et al. 2004; Jurdi and Saxena 2003; Rajab and Patton 2000; Shah 2004; Tremayne 2006). Furthermore, it is believed that the family is the main source of personal identity and security; thus, only through endogamy (within-family marriage) can a family's strength and family members' personal security be assured. For women in particular, marrying a cousin facilitates the transition of a wife to a husband's family in a "soft" manner, without the disruption of existing family bonds or even household arrangements (Gunaid et al. 2004).

In addition, as shown in Inhorn's research (1996), cousin marriages may serve as a buffer against divorce in cases of marital infertility. Familial loyalty seems to play a role in securing such marriages, since male cousins often tend to feel protective toward their female cousins in general, and female cousins often feel an obligation to "take care of their husband's name" (i.e., to protect

his and the family's reputation) in cases of male infertility. In addition, it is widely believed that fertility may be *enhanced* in cousin marriages, because of the salubrious mixing of the "same blood." In a pronatalist setting, the belief that cousin marriages produce more and better offspring may be a major impetus for perpetuation of this practice.

In Inhorn's (1996) Egyptian study, where 35% of marriages were between cousins, consanguineous marriages tended to occur among nonworking women of lower educational backgrounds, a finding that is true across the Middle Eastern region as a whole (Bittles et al. 2002; Hussain and Bittles 2004). However, among men in many communities, the higher the educational-occupational status, the higher the rate of consanguineous unions. One plausible explanation for this pattern is that the "best males" are pressured to remain "within" the family by marrying a cousin. Such males, especially eldest sons, are regarded as valuable assets, who should be conserved within sociofamilial boundaries. This "best males" hypothesis has been forwarded in studies conducted in Yemen and Jordan, but has been questioned as a cause of cousin marriage in studies conducted in Lebanon, Kuwait, and Saudi Arabia (Al Abdulkareem and Ballal 1998; Gunaid et al. 2004; Jurdi and Saxena 2003; Shah 2004).

The educational and literacy levels in Lebanon, the focus of this study, are among the highest in the Middle Eastern region, but the rates of consanguineous marriage are among the lowest. Nonetheless, the level of consanguinity there may be increasing as well (Gunaid et al. 2004). The importance of kinship as manifested in consanguineous marriage in Lebanon remains strong, a powerful means to ensure patrilineal solidarity and property in a society that has been fractured by years of civil war and ongoing political violence (Joseph 1993; 2001). Indeed, 15 years of civil war (1975–1990) resulted in the death of 7% of the Lebanese population, serious injuries in 10% of the population, displacement of up to 24% of the population, and emigration of up to 30% of the population (Inhorn et al. 2008). Many demographic disruptions occurred in Lebanon as a result of the civil war, including most significantly, delayed age at first marriage; decreased family size; an increased proportion of unmarried adult women as a result of high male outward migration and mortality; reduced employment opportunities; and shortages of safe, affordable housing. Because of the dearth of wage-earning males, Lebanese women increased their levels of educational attainment and involvement in the labor force. The influence of higher educational attainment among women has further affected their postwar lives, resulting in what has generally been referred to as a "celibacy trap"—namely, the postponement of marriage to the late 20s, coupled with the dearth of marriageable Lebanese men, has resulted in an increased lifetime expectancy of celibacy (what used to be known as "spinsterhood") for many Lebanese women (Saxena, Kulczyck, and Jurdi 2004; Jabbra 2004). As a result, Lebanese women have become more tolerant of less socially desirable

marriages, including to either younger or much older men, men with lower educational levels, and cousins whom they might not have preferred to marry otherwise.

Current figures demonstrate that nearly one-third of all Lebanese Muslims and nearly 17% of Lebanese Christians marry consanguineously, even though many Christian sects technically forbid close kinship in marriage. In our study of both Muslim and Christian men, approximately one-fifth of all men in the study (16% of cases, 25% of controls) were currently married to their cousins indicating the persistence of consanguineous marriage in this population over time. In addition, fully two-thirds of Muslim men in the study were the product of either first- or second-degree consanguinity, as were one-fifth of the Christian men, indicating the prevalence of consanguinity in previous generations.

To illustrate some of these issues, it is useful to turn to the cases of two infertile Lebanese men, whom we will call "Abbass" and "Hussain." Both volunteered to participate in the study after reading an advertisement placed by the authors in the clinic waiting area. Both offered compelling accounts of their severe male infertility problems, although neither attributed these problems to consanguinity *per se*.

The Case of Abbass

Abbass was the first man to volunteer for the study, perhaps because he had lived in the United States for 7 years, felt favorably toward the U.S., and wanted to practice his English skills with the American anthropologist. He was a tall, robust, sandy-haired man with a large moustache, which, along with his weathered skin, made him look much older than his 34 years. In the interview, which took place in both Arabic and broken English, Abbass proved to be a lively, even jolly interlocutor, who nonetheless wanted to share his deep heartache over aspects of his life that were beyond his control.

A Shia Muslim from a tiny, tobacco-producing village in southern Lebanon, Abbass came from a family of 11 children, as had his father before him. Abbass considered the latter fact quite remarkable, given that his grandfather was missing a testicle but had still managed to produce 11 healthy children.

Abbass and his siblings never intended to move from their hometown. But the Lebanese civil war broke out, and Abbass, still a high school student, was drafted into the Lebanese marines. He was lucky to survive his 2-year period of conscription, and when he was released from the military, he was able to take refuge in Cyprus, and then in America, where he worked at odd jobs in New York City.

As a tall, blond Lebanese man, Abbass found many young American women who were willing to help him with his English and to explore his as yet untapped sexuality. Abbass bragged that he had many girlfriends in "Amrika," but he

was careful to use condoms to prevent an unplanned pregnancy. Meanwhile, through messages sent back to Lebanon, he began to court a respectable young woman, Fatima, his *bint 'amm*, or his FBD. Although she represented the ideal form of cousin marriage, Fatima was also Abbass' love interest, and he was happy that his affections were reciprocated.

After spending 7 years in the United States, Abbass returned to Lebanon, where he married Fatima. When no pregnancy had occurred after 2 years of marriage, the young couple consulted several gynecologists, who deemed Fatima to be healthy and fertile. Abbass, meanwhile, was shown to be azoospermic, that is, there were no spermatozoa in his ejaculate.

Multiple, painful testicular biopsies proved that Abbass was producing sperm in his testicles. But the sperm were trapped inside, because Abbass was lacking a vas deferens, the testicular vessel involved in sperm transport. Abbass described how he felt when he learned this shocking news:

We asked the doctor about what I can do, and he explained to me that there's nothing I can do. Everything else is okay, wonderful. I have sperm inside, and I "come" [ejaculate] when I make love with my wife and it's wonderful. It's "the line" [vas] I don't have. It's not only me; it's my brother and one cousin. I asked the doctor why this happened. The doctor explained to me, "It's biology. It's coming from your mother and father. It's coming to the men in your family."

This problem changed my mind, my life, my prayers. I asked God, "Don't leave me to be like this, never to have children." It broke my life. I want to have my own children too much. I thought about divorce many times. My brain "moved" a lot [he motioned to his head, circling his hand around it]. I thought about my life, my wife, and it was a very, very dangerous period [i.e., he suggests that he was suicidal].

But the first and last is my God. He sees everything. And I decided to leave that to God. If he wants to help, he'll help, but I can't do anything. It's not between your hands or in your brain. This is God's will. I prayed to my God, and I stayed to myself [during this period], even though my wife and I talked and talked, all night some times.

Nobody can know how I felt ... you don't know how I was feeling inside. Anybody who has this problem, he can feel it. [Addressing the anthropologist] You're a doctor, so you can feel it. But other people have no idea how it feels [to be faced with this problem].

About myself, about me, I'm okay now. I looked to my God, and this is what happened to me. I realized that there was not anything wrong with me. I was born with this. Not from a disease. There was nothing I did wrong, and nothing I can do. I am Abbass. I don't need it [a vas deferens] or children. You have to believe in yourself. You have to take care of that first. When you feel like this, then nobody will act differently toward you. I realized that it's not my problem if I don't have the "line." All my family knows [about his medical problem]. I can't keep it from them. Everybody was crying with me when I told them. Everybody thought about this problem and tried to help me. We sold land, 2,000 meters, and I spent all of that for treatment.

Indeed, Abbass was fortunate to have met a knowledgeable urologist, who encouraged Abbass to try intracytoplasmic sperm injection (ICSI), saying, "You can't stop here." ICSI can create children for men such as Abbass with a congenital absence of the vas, through extraction of sperm directly from the testis. Nonetheless, ICSI can also perpetuate genetic disorders into the next generation, particularly among male offspring. Congenital absence of the vas is a definitive marker of the autosomal recessive cystic fibrosis gene, which Abbass, his brother, and cousin all carry. If their wives, who are relatives, carry this familial gene as well, then their children face the threat of cystic fibrosis, a deadly pulmonary condition that debilitates children and kills them by the time they are young adults. For his part, Abbass was never told about his cystic fibrosis carrier status, or if he was counseled, he failed to understand the seriousness of this genetic threat to his future offspring.

With the help of ICSI, Abbass and his wife were able to bear a son, who was 9 months old at the time of the interview. Abbass proudly described him as a "special boy," highly intelligent even though he was still too young to talk. Furthermore, when I met Abbass at the in vitro fertilization (IVF) clinic, he was in the process of helping his younger brother, now a resident of the Netherlands, to obtain ICSI in Lebanon. Abbass was profoundly grateful to the Beirut IVF clinic for giving him the gift of an ICSI son, and he wanted to share this blessing with his younger brother (Figure 6.1). Yet, Abbass was not aware of the debates surrounding ICSI, a technology that

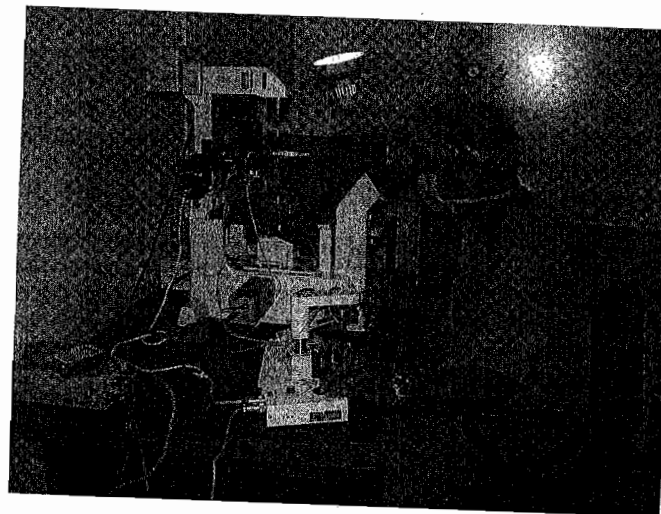


Figure 6.1. Intracytoplasmic sperm injection being performed in an in vitro fertilization clinic in Beirut, Lebanon. (Photo by Marcia C. Inhorn.)

"assists" reproduction, while at the same time "reproducing" genetic defects in the next generation (Bittles and Matson 2000; Chan 2007; Kurinczuk 2003; Ola et al. 2001).

If both Abbass and his brother are lucky, their ICSI offspring will be spared from painful deaths via cystic fibrosis. However, their sons will share the genetic destiny of their fathers, namely, serious male infertility, linked to cystic fibrosis, the likely consequence of generations of consanguinity.

The Case of Hussain

Like Abbass, Hussain was one of the few infertile men who volunteered to participate in the study, without being asked by a clinic staff member. A hulking Lebanese Army commando with tobacco-stained teeth, he was dressed on the day of the interview in camouflage gear and army boots, with a closely shaved head and massive arm muscles bulging out of his uniform. He would not shake the anthropologist's hand when she extended it.³ Nonetheless, he was amazingly candid and forthcoming during the interview, perhaps experiencing some catharsis through the telling of his painful story.

Hussain was a 37-year-old Shia Muslim, who had spent a 20-year career in the Lebanese Army. As a soldier, he had spent a full 15 years "on the front line" in the civil war, experiencing "everything," including participation in combat and living through periods of intense bombing. He does not attribute his male infertility problems to the stresses of the civil war, as many other Lebanese men in this study did. In fact, although he saw many frightening scenes of war and carnage, he said that he never felt fear while participating in actual combat.

Hussain has been married twice. His first marriage occurred when he was only a teen (aged 17), and did not produce any children. His mother-in-law blamed him for the infertility, and so he went to a doctor for a semen analysis. According to Hussain, the semen analysis was normal, so he took the report to his mother-in-law, telling her "The problem is not from me." Although the lack of pregnancy was not the ultimate cause for the divorce, the marriage dissolved before Hussain could prove his fertility. He now doubts the accuracy of his initial semen test.

In his second marriage, Hussain took the safer route by marrying his double first cousin, who was both his FBD and MBD. Hussain himself is the product of multiple generations of consanguinity. His grandparents on both sides were cousins, and both sets of grandparents were related to each other (i.e., the grandfathers were brothers). His mother and father are first cousins (FBD). Hussain has never considered consanguinity as an important factor in his life or health, since cousin marriage is "normal" in his Shia Muslim community in southern Lebanon. He said that his marriage to a tall, attractive, veiled woman

is "happy enough," and that they will stay together, even if they do not have children.

However, Hussain went on to relate a painful 17-year history of male infertility punctuated by hundreds of semen analyses, multiple hormonal injections, four unsuccessful intrauterine insemination attempts (using his sperm), and an unwarranted testicular surgery called varicocelelectomy, which is commonly performed in Lebanon as a money-making venture by unscrupulous urologists. Hussain said that "only God knows" why he is infertile in his second marriage. To his knowledge, there are no other known cases of male infertility in his family, as all of his five brothers (and six sisters) have children. As he explained, "I went to all *good* doctors, specialists and professors in Beirut, but not one of them said, 'You have *this* problem that causes your infertility.'"

Finally, through a loan from the army in the year 2000, Hussain gathered together enough money to undergo one trial of ICSI. The ICSI procedure was performed, but Hussain lamented that "the doctor, he didn't do his best for us." Hussain was elated to learn that his wife was pregnant for the first time after 10 years of marriage. But his happiness lasted only through the delivery, when the nurse came to tell him that a baby son had been born. Minutes later, the nurse reappeared and, according to Hussain, "told me he is a Mongol" (i.e., a baby with Down Syndrome).

"I had a strong shock, and I threw up," Hussain recalled. "I stayed for one month crying. My wife also felt so bad. But I believe in God, and this is what God wants. So *hamdu-lillah* [praise be to God]. If he had lived, we would have raised him. But I felt so bad when he died [8 months later, from a heart defect]. I cried and cried. He was so intelligent. Even though he was a Mongol, it wasn't a 'strong case.'"

Although Down Syndrome is one of the genetic disorders attributable to consanguinity in the Middle East, Hussain has not considered this possibility and is instead trying to mobilize the financial resources for a second ICSI trial. His father is helping him to pay for treatment, but has not been informed about the ICSI, which Hussain and his wife are keeping "top secret." They believe that an IVF or ICSI child would be ridiculed in their conservative Muslim community. "Because all my family have children, perhaps in the future they'll say to my child, 'You are an in vitro child.' Not all people understand IVF, what it means. Perhaps they will think bad things about it, like that we've used other people's sperm [which is forbidden in most of the Muslim world]."

As Hussain explained at the end of the interview,

The child, he completes the family, and no marriage is completed without the child. Because they are fun, children make for a nice family life, with happiness and humor. We must have children to be happy. No couple is happy without them. My wife and I are happy now, but to complete our happiness, we must have children.

Given his history of long-term, severe male infertility, and the birth of a child who died from a serious genetic disorder, Hussain and his wife are ideal candidates for genetic counseling. Repeating ICSI may not be advisable, as ICSI is known to perpetuate serious genetic defects into the next generation. However, genetic screening and genetic counseling are not well-developed specialties in Lebanon, or in other parts of the Middle East. Therefore, Hussain and his wife will probably not receive wise counsel about their chances for conceiving a future healthy child. At the time of the interview, they were visiting the IVF clinic in the hope of beginning their second round of ICSI.

Conclusion

Given these stories and the overall findings of this study, counseling infertile Middle Eastern couples about possible genetic problems relating to male infertility seems necessary, especially in the light of the rapid expansion of ICSI in this region. For example, in Lebanon, a relatively small country of only 10,452 km² area and 4.3 million people, nearly 20 IVF centers serve the population, one of the highest numbers per capita in the world. The use of ICSI in this population may be inadvertently perpetuating genetic disorders into future generations in a significantly consanguineous population with limited comprehension of the basic principles of genetics or risks of consanguinity.

Indeed, in Lebanon, as in other regions of the Middle East, religion is often invoked to explain genetic diseases as manifestations of God's will, as seen in both cases above. Furthermore, consanguineous marriages are common, while genetic conditions are relatively uncommon. Thus, community members are often unwilling to link consanguinity to genetic disorders, particularly when there are strong religious, sociocultural, and economic incentives for marrying cousins (Hussain 1999, 2002).

A significant percentage of Lebanese couples—30% of Muslims and 17% of Christians in the general population, and 20% of the men in our study—continue to marry consanguineously. Even though educational levels are relatively high in Lebanon, many men have never studied reproductive biology or basic genetics in their high school or university curricula. In general, "genetic thinking" is not part of the cultural milieu in Lebanon or other parts of the Middle East. Genetic testing and genetic counseling are also quite rare, even in university-based medical settings. Thus, few Lebanese men question the potential genetic consequences of marrying their close female relatives, particularly when cousin marriages are highly valued for a variety of reasons.

In Lebanon, one of the consequences of cousin marriages may be male infertility among the offspring of consanguineous unions. As our study has

revealed, relatively high levels of consanguinity over multiple generations in Lebanon may be leading to family clustering of genetically based male infertility cases, particularly among Lebanese men with the most severe forms of infertility.

Anthropologists have spent more than a century studying kinship patterns and practices of cousin marriage across the globe (Fox 1984; Holy 1996; Westermarck [1903] 2005). Thus, they bring special insights and sensitivity to the study of a practice that "makes sense" in the lives of the men and women around the world who enter into these unions, often because of tradition and family arrangement, but sometimes out of desire and love for one another. Consanguineous marriage is not a practice to be condemned as "backward" or "dangerous." Rather, it is a practice with elevated genetic risks that need to be thoroughly explained to susceptible populations through culturally tailored messages that are neither frightening nor offensive. Revealing the relationships between consanguinity and genetic disorders, including those that cause male infertility, will require not only basic medical and epidemiological research, but also comprehensive religious, governmental, and media-based intervention programs, which set in place the basic groundwork for effective public health preventive measures (Panter-Brick 1991). Epidemiologists and anthropologists working together can help shed light on the health risks of consanguinity among the populations who support this practice for a variety of important reasons. Their ethnographic findings may lead to the development of culturally sensitive public health education messages, ones that support genetic counseling and risk management, without condemning consanguineous marriage practices *per se*.

Acknowledgments

The authors thank the National Science Foundation (BCS 0549264) and U.S. Department of Education Fulbright-Hays Faculty Research Abroad Program for financial support of this study. The first author thanks the men in Lebanon who made this study possible by speaking candidly about their infertility and reproductive lives. Thanks also go to Abbass Fakhri, Mary Ghanem, Azhar Ismail, Hanady Sharara, and Khaled Sakhel for research assistance.

Notes

1. Since the year 2000, numerous peer-reviewed journal articles on this topic have been published, as shown in our bibliography: Al-Gazali (2005); Alkhalaf et al. (2002); Gunaid et al. (2004); Hamamy et al. (2005); Hussain (2002); Jurdi and Saxena (2003);

Mohammed et al. (2007); Mumtaz et al. (2007); Rajab and Patton (2000); Raz et al. (2003); Saadat et al. (2004); Shavazi et al. (2006); Sueyoshi and Ohtsuka (2003); and Tamim et al. (2003).

2. The option to be tape-recorded was presented to each informant on the written informed consent form. Most informants asked about this, and when told that it was not necessary to tape-record the interview, they uniformly declined, usually with visible relief. This "tape-record-less" strategy, which the first author has used in most interviews in Egypt and Lebanon, requires her to take verbatim shorthand notes, which she learned through a previous career as a medical journalist.

3. Many conservative Muslim men will not physically touch a woman other than their wives or close female relatives. Shaking hands across genders is replaced by holding one's outstretched hand over the heart, as a gesture of greeting and good will.

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