Ethnicity differences account for genetic, environmental, lifestyle, and reproductive variables, influencing the rate of twinning (Nylander, 1981). Frequently, ethnic differences correlate with variable perinatal care leading to differences in outcome. Free access to antenatal care, and to facilities for delivery and neonatal care is available for the entire population in Israel, and therefore differences attributed to levels of medical care are practically negligible. We previously evaluated the overall relationship between ethnicity and outcome in a population-based cohort of mothers of twins (Goldman et al., 2001). However, the overall comparison may have masked some differences that could be present. The purpose of this study was to evaluate whether ethnicity is associated with differences in perinatal outcome in randomly selected, matched-controlled Israeli Jewish and Muslim mothers of twins.

Patients and Method

We used data of the Israeli Birth Registry obtained through the Central Bureau of Statistics, which includes, as required by law, all deliveries in Israel. The database of 12,785 twin pairs delivered during the period 1993–1998 has been used to select 12,567 pairs with known maternal parity (98.3%), complete birth weight data, and neonatal gender. We randomly selected 2388 Jewish and 2388 Muslim mothers matched for maternal age and parity. We selected 2388 mothers because this was the maximal number of mothers to accommodate all maternal ages and all parities in a 1:1 (Muslim:Jewish) quantitative relationship. We selected the 2388 Jewish mothers out of the Jewish maternal group based on a case-control method, and randomised selection inside the controlled group.

The data were analysed by the Microsoft Excel® program (Microsoft Corporation, Redmont, Washington). In addition, we studied in the entire population the following variables: change in twinning rate during the period 1993–1998, seasonality, urban or village origin of the family, maternal age and parity, twin gender combination, birth weight, total twin birth weight (TTBW: birth weight of twin A + twin B) and the percent inter-twin birth weight discordance (inter-twin birth weight difference divided by the birth weight of the larger twin), low birth weight (LBW) and very LBW (VLBW) were defined as birth weights less than 2500g and 1500g respectively.

We used the True EPISTAT Software (Math Archives, Round Rock, Texas) and SPSS 7.5.1 software (SPSS Inc.) for statistical analysis. The $\chi^2$ test was used to compare frequencies and Student’s $t$ test was used to compare continuous variables. Probability values less than .05 were considered significant.

Results

During the study period, we found a consistent rise in the number of twin deliveries among Jewish mothers while the number of Muslim mothers remained relatively constant (Figure 1). Twinning rates for the Jewish and Muslim populations in Israel over the study period are shown in Figure 2. Since 1994 a constant rise in twinning rate among the Jewish population is clear, whereas in Muslim families a rise was registered during the latter years only.

Both ethnic groups display similar seasonality with relatively higher rates at the second half of the year (Figure 3). Although both sub-populations are predominantly urban, Muslim families originated significantly more often from rural areas (14.1% vs. 10.3% $p < 0.0005$). Muslim mothers were significantly younger than Jewish mothers (28.2±5.7
vs. 30.5±5.2, \( p < 0.0005 \), the most significant difference was in the group of mothers less than 20 years of age where 75% of the mothers were Muslim (Figure 4). Muslim women delivered twins in a higher mean parity than Jewish women (2.3±2.2 vs. 1.3±1.6 \( p < 0.005 \) CI–1.1, –0.9). When twin gender combination was examined, we found similar frequencies of 60.7% (5873) vs. 63.4% (1620) for unlike-sexed twins in the Jewish and Muslim groups respectively.

A total of 4776 records (38% of the total population) including 2388 Muslim mothers matched for parity and age with 2388 Jewish mothers. The matching characteristics are shown in Table 1. The variables studied are shown in Table 2. Resemblance between the Israeli Jewish and Muslim populations was found in all parameters tested.

Mean twin birth weight was almost identical in both populations with similar standard deviation. Both Jewish and Muslim mothers had no significant differences in the percentage of VLBW and LBW twins, as well as the TTBW and the inter-twin discordance.

### Discussion

Twinning is subject to changes by a number of factors, including maternal age, parity, social class (Murphy & Botting, 1989) and ethnicity (Nylander, 1981). Immigration and interethnic mixing modify twinning rates as well (Pollard, 1995). It seems that ethnic origin is the most consistent factor which actually comprises all other factors as part of marital and maternity customs.

Previous report from Israel, compared Occidental Jews (immigrated from Europe and America) and Oriental Jews (immigrated from Africa and Asia). Mothers of Oriental origin, emigrating mainly from Muslim countries, had a higher rate of twinning — 10.4 per 1000 live birth, com-
pared to 8.9 in Occidental Jewish families (Modan et al., 1968). A comparison between Jewish and Bedouin populations in southern Israel showed an increase in dizygotic twinning in the whole population with time (1970 and 1986), largely due to an increased rate in the Bedouin population. The authors suggested that while dizygotic twinning rates are influenced by environmental factors, the monozygotic twinning rates are not (Picard et al., 1989).

Twinning rates among Muslim population is usually higher than among other population in the same country. In West Bengal, rates were 20.48 and 10.57 per 1000 deliveries for Bengalee Muslim population and the Bengalee Hindu caste population. The same correlation was found in different populations in India. This increased twinning rate may be due to the greater amount of inbreeding in the Muslim population (Das Chaudhuri et al., 1993).

Twinning rates were shown to be different among different ethnic groups, and higher among minorities in the same geographical area. Differences between Afro-Americans, whites, and Asians were found in California with significant differences even within the Asian group (Pollard, 1995). Significant differences in twinning rate were found among Indian populations living in different continents (Pollard, 1985). In Malawi, families of minor ethnic origins have an unusually high twinning rate compared to the main ethnic group. A district with a mixed ethnic population, had by far the lowest rate (Pollard, 1996). Numerous studies have documented changes in twinning rates in spontaneous conceptions over time. One example shows the change from 0.7% to 1.5% the mid 18th century to 1987 among the Hutterites (Nonaka et al., 1993).

In this study the rate of male and female newborns was almost the same among Jewish and Muslim populations. No significance was found when maternal age, season, TTBW, discordance and birth year were compared. Differences between like-sexed and unlike-sexed twin pairs were not significant. In one study (Picard et al., 1991) the proportion of males in the Jewish subpopulation was significantly lower in twins than in singleton births; parity increased the odds for male twin birth while maternal age had the inverse effect. In the Bedouin subpopulation, the sex ratio did not differ significantly from that of singletons, and no consistent patterns were found by maternal age and parity. In South India, like-sexed pairs were lower than that of unlike-sexed (Rao et al., 1983).

We found a seasonal variation of twinning in our population as was also shown by Fellman and Eriksson (1999) during the spring-summer season in the Danish population, indicating a stronger seasonal variation for the twin maternities than for the general maternities. The authors assumed that some factors affected fecundity during summer-autumn and around Christmas time, making them prone to polyovulation and/or more able to complete a multiembryonic gestation. Canadian dizygotic twinning rates were shown to have a seasonal variation with an October maximum (Elwood, 1978). In Japan the highest rates were during April, with the lowest rate in September (Imaiizumi, 1992). In the Hutterite population a significant seasonal variation was also found, significantly lower in May-July during the years until 1965 (P < 0.01) (Nonakaet al., 1993). Nylander (1981) noted no significant association between twinning and seasonality between African and Caucasian populations in Nigeria. In Israel, the peak month for the birth of monozygotic twins was September in Jewish and Bedouin populations, while the maximum number of deliveries occurred in January for Bedouins and August for Jews. An autumnal peak was found, which was independent of ethnic origin (Picard et al., 1990). It seems that one as yet undefined seasonal factor affects the rates of multiple birth. It is clear that environmental factors, as well as those related to family planning programs influence the decision of conception and thereby the time of delivery.

The different maternal age and parity between Jewish and Muslim mothers could be explained by the two different cultures. Muslim motherhood starts usually earlier and contraception is much less practiced due to religious grounds and lower socioeconomic status in Israel. In contrast, the majority of the Jewish women postpone motherhood to older age. The reason for the higher rate of twinning among Jewish primiparas may be the more frequent use of assisted conceptions. Furthermore, although no effect of parity on the Jewish monozygotic twinning rate was found, this rate was directly affected by parity in Bedouin women. Both maternal age and parity affected the twinning rates in both populations; however, the effects were not additive without interaction between maternal age and parity (Picard et al., 1989). In Canada (Elwood, 1978) and Taiwan (Chen et al., 1987) increased twinning was noted with both maternal age and with the number of previous livebirths. In one study the higher the maternal age, the lower the twinning rates were, while the higher the parity, the higher the rates (Chen et al., 1992). In Ethiopia it was shown that the peak prevalence was seen after the sixth parity and in mothers 40–44 years old. Although we have no data on the number of twin deliveries at home in this study group, the monozygous and dizygous twinning rates per thousand deliveries tended to increase with both parity and maternal age (Zein, 1989).

Based on the data shown in our case-control comparison between Israeli Jewish and Muslim mothers of twins, we conclude that no significant differences in perinatal outcome were found between the two populations. We assume that free access to medical care, rather than different socioeconomic or behavioral variables, contributed to this similarity.

References
Murphy, M., & Bottig, B. (1989). Twinning rates and social class in Great Britain. Archives of Disease in Childhood, 64(2), 272–274.


