



## Risk factors of underutilization of childhood immunizations in ultraorthodox Jewish communities in Israel despite high access to health care services

Khitam Muhsen<sup>a,\*</sup>, Reem Abed El-Hai<sup>a</sup>, Anat Amit-Aharon<sup>b</sup>, Haim Nehama<sup>b</sup>, Mervat Gondia<sup>a</sup>, Nadav Davidovitch<sup>c</sup>, Sophy Goren<sup>a</sup>, Dani Cohen<sup>a</sup>

<sup>a</sup> Department of Epidemiology and Preventive Medicine, School of Public Health Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel

<sup>b</sup> Public Health Services, Tel Aviv Municipality, Tel Aviv, Israel

<sup>c</sup> Ben Gurion University, Beer Sheva, Israel

### ARTICLE INFO

#### Article history:

Received 22 September 2011

Received in revised form 15 January 2012

Accepted 17 January 2012

Available online 28 January 2012

#### Keywords:

Routine vaccination

Children

Underutilization

Refusals

Parental beliefs

Ultraorthodox

### ABSTRACT

**Background:** The risk factors of underutilization of childhood vaccines in populations with high access to health services are not fully understood.

**Objectives:** To determine vaccination coverage and factors associated with underutilization of childhood vaccines in a population with sub-optimal vaccination compliance, despite a high health care access.

**Methods:** The study was conducted among 430 children from ultraorthodox Jewish communities in the Bnei Brak city and Jerusalem district. Data on immunization status, socio-demographic factors and on parents' attitudes regarding vaccines were obtained from medical records and through parents' interviews.

**Results:** The proportion of fully vaccinated children was 65% in 2- to 5-year-old ultraorthodox children from Jerusalem district, and 86% in 2.5-year-old children from Bnei Brak city. The factors that were significantly associated with vaccines underutilization in Bnei Brak were having >6 siblings, maternal academic education, parental religious beliefs against vaccination, perceived risk of vaccine preventable diseases as low, and mistrust in the Ministry of Health (MOH). Similarly, in Jerusalem, religious beliefs against vaccination, and the perceived low risk of vaccine preventable diseases significantly increased the likelihood of under-immunization, while having a complementary health insurance was inversely related with vaccines underutilization.

**Conclusions:** The risk factors of under-immunization are in part modifiable, by means of health education on the risks of vaccine preventable diseases and by improving the trust in the MOH. The leaders of the ultraorthodox communities could play an important role in such interventions.

© 2012 Elsevier Ltd. All rights reserved.

### 1. Introduction

Vaccines have substantially reduced the global burden of infectious diseases and are considered as one of the most important achievements in public health [1–3].

Paradoxically, as a result of the decrease in the vaccine preventable diseases, parents in modern societies are not familiar with these diseases. For these parents the threat of vaccine preventable diseases becomes less concrete [2–4], and therefore they may reconsider the need of vaccinating their children [5]. In

addition, concerns regarding vaccine safety [6] and sometimes barriers towards access to health services [5,7,8], might in part explain underutilization or non-compliance with childhood immunization.

In Israel, the reported vaccination coverage is over 90% at the age of two years [9]. Early childhood immunizations are given through Family Health Centers (FHCs) spread all over the country. Despite the good access to routine childhood immunizations, there is evidence of underutilization of vaccines in ultraorthodox Jewish communities in Israel. This population has experienced frequent and large outbreaks of vaccine preventable diseases [10–12], not only in Israel, but also in Europe [13,14] and in the United States [15].

The aims of the present study were to determine the coverage and risk factors of underutilization (delay, parents' refusal) of childhood vaccinations in the ultraorthodox Jewish community in Israel, a population suspected to have suboptimal vaccination coverage.

\* Corresponding author. Present address: Center for Vaccine Development, University of Maryland Medical School, 685 W. Baltimore Street, HSF 480, Baltimore, MD 21201, United States. Tel.: +1 410 706 2493; fax: +1 410 706 6205.

E-mail addresses: [kmuhsen@medicine.umaryland.edu](mailto:kmuhsen@medicine.umaryland.edu), [khitam15@yahoo.com](mailto:khitam15@yahoo.com) (K. Muhsen).

## 2. Methods

### 2.1. Study population

The study target population comprised children belonging to ultraorthodox Jewish communities in Tel Aviv and Jerusalem districts.

About 10–14% of the Jewish population in Israel is ultraorthodox; this subpopulation is characterized by large families, high fertility rates and living in crowded conditions [16–18].

### 2.2. Sampling and sampling frame

The sampling frames were the ultraorthodox Jewish city Bnei Brak in the Tel Aviv district, and ultraorthodox neighborhoods in Jerusalem district. Three hundred children aged 2–2.5 years (birth year 2005) from Bnei Brak were randomly selected from the “newborns file” that contains information on all live births in the district. These children were located through FHCs or through the population registry. Overall data on vaccination status were available for 260 (86.7%) children from Bnei Brak. In Jerusalem district, a sample of uncovered telephone numbers registered in the national telephone company in ultraorthodox neighborhoods was randomly selected. Eligible households were those having a child aged 2–5 years. After exclusion of fax and commercial numbers and households without an age-eligible child, the number of candidate households was 2360, of these, 1443 could not be located, 19 were excluded due to language problems, thus leaving a total of 898 households that were successfully contacted. Of the 898 households, 270 (30.1%) completed the interview, and 628 (69.9%) refused to participate in the study.

The risk factors of vaccines underutilization were studied in the framework of a case–control study. This study was conducted in a sub-sample of the survey participants and among parents who actively declared refusal to vaccinate their children.

In the case–control study we compared socioeconomic and demographic data, and parents' attitudes on vaccines among children who were not adequately vaccinated for their age (cases), with those of children who were adequately vaccinated, serving as the control group. The cases and controls were participants of the survey who met the definition below and whom parents agreed to be interviewed. Since the number of parents who refused to vaccinate their children in the random sample was relatively small in Bnei Brak, we offered parents known to the FHCs as vaccine refusals to participate in the study.

The definition of cases and controls was based on the number of vaccine doses that the child received from birth until the survey (age 2.5 in Brak and age 2–5 years in Jerusalem). According to the MOH, the recommended vaccines (and number of doses) in the early childhood vaccination schedule of 2005 that should be completed by age of 2–2.5 years were: Mumps Measles Rubella – MMR (1), Hepatitis B – HBV (3), Hepatitis A – HAV (2), Diphtheria–Tetanus – DT (4), acellular Pertussis – aP (4), Inactivated Polio Vaccine – IPV (4), and Hemophilus influenza type b – Hib (4). Children were classified as cases if they received  $\leq 20$  doses, of the 22 recommended doses in the 2005 routine vaccination schedule. Adequately vaccinated children (controls) were those who received 21–22 of these vaccine doses. Cases and controls were selected from the same geographic area.

### 2.3. Collection of data

Data on immunization status were collected from medical records or parental interviews. The interviews were performed by trained interviewers by telephone. Parents (mostly mothers) were asked to report the date in which each vaccine dose was given as it is

documented in the child's immunization card. Socio-demographic data and information on parents' attitudes were collected through parents' interviews using a structured questionnaire.

The questionnaire included questions on the child's sex, birth order, number of siblings, household crowding (number of persons living in the household divided by the number of rooms in the household), parental education and parental age, questions on the parents' attitudes towards immunizations safety, perceived risk of vaccine preventable diseases, preference of natural immunity, religious beliefs against immunizations, vaccination following a rabbi recommendation, trust in MOH regarding vaccination, having a complementary health insurance, and markers of natural life style (preference of natural devilry without medical staff, preference of alternative medicine over conventional medicine, duration of breastfeeding, using epidural anesthesia, and opposing vitamin K administration to the baby after birth).

Attitudes were defined according to the score on several 2- to 7-item summative scales (Appendix A), in which mothers were asked to rank their agreement with the items on a scale between 1 and 4, where 1 was “totally agree” and 4 was “totally disagree”. The classification of the mothers' agreement with each score was as following: those who scored below the median were considered as “disagree” with a certain attitude, while scoring the median or higher were classified as “agree” with the attitude.

### 2.4. Statistical analysis

Proportions and 95% confidence intervals (CI) of children who were not vaccinated, partially vaccinated, and who received all the recommended vaccines in the routine immunization program (fully vaccinated) were calculated. To examine the risk factors of underutilization of childhood vaccines, bivariate analysis was performed using Chi square test and Fisher exact test for categorical variables, and Student *t*-test for continues variables. Crude odds ratio (OR) and 95% CI were calculated. Multivariate analysis was performed using stepwise logistic regression models. The criteria for selecting the independent variables that were included in the multivariate analysis were the combination of several factors; the significance level of the association with vaccines' underutilization in the bivariate analysis ( $P < 0.05$  in Bnei Brak and  $P < 0.1$  in Jerusalem), the presence of correlations between the independent variables (significantly correlated variables were not included in the same model), and our *a priori* hypothesis. Adjusted OR and 95% CI were driven from the logistic regression models. Correlations between independent variables were examined using Spearman correlation coefficient. Two tailed  $P < 0.05$  was considered statistically significant. The analyses were performed separately for each geographic region.

## 3. Results

The proportion of fully vaccinated children was 65.9% (95% CI 60.1–71.3) in Jerusalem, compared with 86.1% (95% CI 81.4–89.8) in Bnei Brak. The respective proportion of partially vaccinated children was 28.2% (95% CI 23.1–33.8), and 12.7% (95% CI 9.2–17.3), while 5.9% (95% CI 3.7–9.4), and 1.2% (95% CI 0.4–3.33), were not vaccinated with any vaccine in Jerusalem and Bnei Brak, respectively

In Bnei Brak, the percent of unvaccinated children ranged from 1.2% for MMR to 6.5% for DT, while in Jerusalem this percent ranged from 7.4% for MMR to 15–19% for components of the pentavalent vaccine (DTaP–Hib–IPV). The proportion of children who completed two doses of hepatitis A vaccine was 43–65% (Table 1).

**Table 1**  
Vaccination coverage of the routine childhood immunizations.<sup>a</sup>

Vaccine (no. doses)	Bnei Brak		Jerusalem	
	Vaccinated	Not vaccinated	Vaccinated	Not vaccinated
HBV (3)	251 (96.5)	9 (3.5)	246 (90.1)	27 (9.9)
DT (4)	243 (93.5)	17 (6.5)	229 (84.8)	41 (15.2)
P (4)	244 (93.8)	16 (6.2)	226 (84.6)	41 (15.4)
HIB (4)	244 (93.8)	16 (6.2)	221 (81.3)	51 (18.8)
IPV (4)	244 (93.8)	16 (6.2)	232 (84.7)	42 (15.3)
MMR (1)	257 (98.8)	3 (1.2)	249 (92.6)	20 (7.4)
HAV (2)	112 (43.1)	148 (56.9)	175 (68.1)	82 (31.9)

<sup>a</sup> Not vaccinated: Did not receive the vaccine either due to delay or parental refusal. HBV: Hepatitis B virus, DT: Diphtheria Tetanus, P: Pertussis, HIB: Hemophilus influenza type b, IPV: Inactivated Polio Vaccine, MMR: Mumps Measles Rubella, HAV: Hepatitis A.

### 3.1. Bivariate analysis of the factors associated with vaccines underutilization

In Bnei Brak, academic maternal education, higher mean maternal and paternal age, having more than 6 siblings, and living in crowded households were significantly associated with increased likelihood of vaccines underutilization (Table 2). Similarly, children of parents who preferred naturally acquired immunity over vaccine-induced immunity, who believed that the risk of vaccine preventable diseases is low, who hold religious beliefs against immunizations, and who did not trust the MOH in respect to vaccination, had increased the likelihood of vaccines underutilization as compared with children whose parents did not agree with such attitudes. Using epidural anesthesia was significantly less common among mothers of children who were not adequately vaccinated than among mothers of adequately vaccinated children. Mothers of the former group believed that vaccines are traumatic for children more often than the later group (Table 2). In Jerusalem, having complementary health insurance was significantly and inversely associated with vaccines underutilizations (Table 3). Borderline statistically significant associations with vaccines underutilization were found for parental religious beliefs against vaccination, preferring alternative medicine over conventional medicine, and opposing vitamin K administration to the baby after birth (Table 3).

### 3.2. Multivariate analysis of the risk factors of vaccines underutilization

In Bnei Brak, several socio-demographic variables that were significantly associated with vaccines underutilization in the bivariate analysis were highly and significantly correlated. The Spearman coefficient was 0.90 for maternal and paternal age ( $P < 0.001$ ). For maternal age and number of siblings the Spearman coefficient was 0.64 ( $P < 0.001$ ), and for crowding conditions at home and number of siblings it was 0.61 ( $P < 0.001$ ). From these variables selected the variable “number of siblings” to be included into the multivariate analysis, since our *a priori* hypothesis was that children from large families may have increased likelihood of under-immunization. In addition we included into the multivariate analysis the variables maternal education, perceived risk of vaccine preventable diseases, preference of natural immunity over vaccine-induced immunity, holding religious beliefs against vaccines, using epidural anesthesia, and trust in MOH concerning vaccines. The results of this analysis showed that children of larger families and more educated mothers had increased odds of vaccines underutilization, and so were children of parents holding religious beliefs against vaccines, who considered the risk of vaccine preventable diseases as low and who did not trust MOH regarding immunizations, as compared with children whose parents did not hold such beliefs (Table 4). The variables that were included in the multivariate analysis of the data from Jerusalem were perceived risk of vaccine preventable diseases, holding religious beliefs

against vaccines, attitudes towards vaccines' safety, preference of alternative medicine, opposing vitamin K administration, and having complementary health insurance. The risk factors of vaccines underutilization in this region were parents considering the risk of vaccine preventable diseases as low and holding religious beliefs against vaccines, while having complementary health insurance was strongly and inversely associated with vaccines underutilization (Table 4).

## 4. Discussion

This study quantifies and characterizes the underutilization of childhood immunizations in the ultraorthodox Jewish community in Israel, which was suspected for low level of pediatric vaccination coverage despite the good access to health care. Under-immunization may reduce the population immunity levels below the herd immunity threshold, and can facilitate the occurrence of vaccine preventable diseases epidemics. This was at least in part the cause of the recent outbreaks of mumps and measles in Israel that started in communities with lower vaccination coverage level (e.g. ultraorthodox Jewish communities) and spread all over the country [10,11].

The proportion of children who were adequately vaccinated for their age was relatively low: 86% in Bnei Brak and 66% in Jerusalem. The proportion of children who were not vaccinated with any vaccine was 1.2–6%. Only 43–68% of children completed two doses of hepatitis A vaccine; it is possible that the low frequency of visits to the FCH at the ages 18–24, when this vaccine is given, lowers chances of catch up.

The risk factors for early childhood underutilization varied slightly between the geographic areas. In Bnei Brak the risk factors were having >6 siblings, maternal academic education, having parents holding religious beliefs against vaccination, perceiving the risk of vaccine preventable diseases as low and with mistrust in MOH. In Jerusalem the risk factors were having parents holding religious beliefs against vaccination, and perceiving the risk of vaccine preventable diseases as low. Having a complementary health insurance was positively associated with immunizations.

It was previously shown that under-immunization and vaccination delay were more common among mothers having a large number of children [6,19]. This could be the result of limited time and other barriers to attend the FCH at the scheduled date for immunization due to difficulties and burden of taking care of a larger number of children. It was reported that parents who refuse to vaccinate their children are more educated [6,20] than those who do not. Other studies did not find such an association [21], or reported a positive association between low maternal education and high level of concern regarding vaccines safety [22]. In common with previous studies [23,24], we found that perceiving the risk of vaccine preventable diseases as a low risk was associated with 4.3–4.9 fold significant increased likelihood of under-immunization. It seems that parents' decision to vaccinate

**Table 2**  
Risk factors of underutilization childhood immunizations, Bnei Brak.<sup>a</sup>

	Cases (N = 31)	Controls (N = 77)	OR (95% CI)	P value
	N (%)	N (%)		
Sex				
Males	15 (48.4)	34 (44.2)	1.19 (0.51–2.76)	0.68
Females	16 (51.6)	43 (55.8)	Reference	
Birth order				
1st	2 (6.5)	16 (20.8)	Reference	0.09
2nd +	29 (93.5)	61 (79.2)	3.80 (0.80–36.0)	
No. siblings				
≤6	14 (45.2)	57 (77.0)	Reference	0.001
>6	17 (54.8)	17 (23.0)	4.07 (1.67–9.92)	
Maternal education				
Academic	12 (38.7)	13 (17.1)	3.06 (1.19–7.81)	0.01
Not-academic	19 (61.3)	63 (82.9)	Reference	
Paternal education				
Yeshiva student	22 (71.0)	57 (75.0)	0.81 (0.30–2.37)	0.80
Else	9 (29.0)	19 (25.0)	Reference	
Household crowding <sup>b</sup>				
Low	12 (38.7)	46 (63.9)	Reference	0.01
High	19 (61.3)	26 (36.1)	2.80 (1.17–6.67)	
Paternal age, years	37.6 (5.3)	31.4 (6.7)	1.15 (1.06–1.25)	<0.001
Maternal age, years	33.5 (5.7)	30.0 (5.6)	1.11 (1.02–1.20)	0.005
Vaccines are safe				
Disagree	21 (67.7)	37 (48.1)	2.27 (0.94–5.45)	0.06
Agree	10 (32.3)	40 (51.9)	Reference	
Prefer natural immunity				
Disagree	14 (45.2)	51 (66.2)	Reference	
Agree	17 (54.8)	26 (33.8)	2.38 (1.01–5.57)	0.04
The risk of vaccine preventable diseases is low				
Disagree	11 (35.5)	58 (75.3)	Reference	<0.001
Agree	20 (64.5)	19 (24.7)	4.22 (1.75–10.20)	
Vaccination is traumatic				
Disagree	24 (77.4)	77 (100.0)		
Agree	7 (22.6)	0		<0.001
Religious beliefs against vaccination				
Disagree	15 (48.4)	66 (85.7)	Reference	<0.001
Agree	16 (51.6)	11 (14.3)	6.40 (2.47–16.55)	
Vaccination following the rabbi recommendation				
Disagree	16 (51.6)	41 (53.2)	Reference	0.87
Agree	15 (48.4)	36 (46.8)	0.87 (0.46–2.45)	
Trust in MOH regarding vaccines				
No	11 (35.5)	8 (10.4)	4.74 (1.68–13.99)	0.04
Yes	20 (64.5)	69 (89.6)	Reference	
Having a complementary health insurance				
No	5 (16.1)	12 (14.6)	Reference	1.00
Yes	26 (83.9)	65 (84.4)	0.96 (0.28–3.83)	
Prefer natural devirly				
No	28 (90.3)	76 (98.7)	Reference	
Yes	3 (9.7)	1 (1.3)	8.14 (0.81–81.56)	0.07
Using epidural anesthesia				
No	16 (51.6)	18 (23.4)	3.49 (1.44–8.43)	0.004
Yes	15 (48.4)	59 (76.6)	Reference	
Opposing vitamin K administration				
No	29 (93.5)	75 (97.4)	Reference	0.57
Yes	2 (6.5)	2 (2.6)	2.58 (0.34–19.22)	
Breastfeeding duration (months)	12.5 (6.1)	10.3 (5.9)	1.06 (0.99–1.14)	0.08
Prefer alternative medicine				
No	24 (77.4)	68 (88.3)	Reference	
Yes	7 (22.6)	9 (11.7)	2.20 (0.73–6.56)	0.22

<sup>a</sup> OR (CI): Odds Ratio and confidence intervals. MOH: Ministry of Health.

<sup>b</sup> Household crowding was calculated as the number of persons living in the household divided by the number of rooms in the household. Household crowding was considered high if it was higher than the median level.

their child greatly depends on weighting the chances of their child to get the vaccine preventable diseases and the expected severity of the disease.

We found that mistrust in MOH regarding vaccines was a strong predictor of under-immunization. Negative attitudes towards healthcare providers and the government were related with high level of parental concerns regarding vaccines safety [22], and vaccine exemption in the United States [24].

In our study, having a complementary health insurance was associated with decreased likelihood of under-immunization in

children from Jerusalem. In Israel all citizens have health insurance by the Health Insurance Law, and routine childhood vaccination is given to all residents, regardless of health insurance status. In our opinion, having a complementary insurance is a marker of health care use habits, rather than a barrier towards immunizations.

Children of parents holding religious beliefs against vaccines were at increased risk of under-immunization. It seems that the leaders of the ultraorthodox religious communities should be involved in any intervention aiming to increase immunization coverage in these communities.

**Table 3**  
Risk factors of underutilization of childhood immunizations, Jerusalem.

	Cases, (N=28)	Controls, (N=83)	OR (95% CI) <sup>a</sup>	P value
	N (%)	N (%)		
Sex				
Males	12 (42.9)	37 (44.6)	0.93 (0.38–2.23)	0.87
Females	16 (57.1)	46 (55.4)	Reference	
Birth order				
1st	5 (17.9)	8 (10.4)	Reference	0.32
2nd +	23 (82.1)	69 (89.6)	0.53 (0.15–1.79)	
No. siblings				
≤6	15 (62.5)	43 (68.3)	Reference	0.62
>6	9 (37.5)	20 (31.7)	1.29 (0.48–3.44)	
Maternal education				
Academic	3 (14.3)	16 (28.6)	0.42 (0.07–1.75)	0.24
Not-academic	18 (85.7)	40 (71.4)	Reference	
Paternal education				
Yeshiva student	20 (74.1)	52 (74.3)	0.98 (0.35–2.72)	0.98
Else	7 (25.9)	18 (25.7)	Reference	
Household crowding <sup>b</sup>				
Low	7 (38.9)	31 (53.4)	Reference	0.41
High	11 (61.1)	27 (46.6)	1.80 (0.61–5.30)	
Paternal age, years	34.9 (7.6)	36.2 (8.1)	0.97 (0.90–1.05)	0.59
Maternal age, years	32.9 (6.0)	34.4 (6.8)	0.96 (0.80–1.05)	0.43
Vaccines are safe				
Disagree	16 (76.2)	59 (76.6)	0.98 (0.31–3.03)	1.00
Agree	5 (23.8)	18 (23.4)	Reference	
Prefer natural immunity				
Disagree	10 (41.7)	46 (59.0)	Reference	
Agree	14 (58.3)	32 (41.0)	2.01 (0.79–5.09)	0.13
The risk of vaccine preventable diseases is low				
Disagree	7 (31.8)	41 (56.2)	Reference	0.05
Agree	15 (58.3)	32 (43.8)	2.74 (1.00–7.53)	
Vaccination is traumatic				
Disagree	26 (96.3)	77 (96.2)	Reference	
Agree	1 (3.7)	3 (3.8)	0.98 (0.09–9.90)	1.00
Religious beliefs against vaccination				
Disagree	11 (57.9)	54 (78.3)	Reference	0.08
Agree	8 (42.1)	15 (21.7)	2.61 (0.89–7.67)	
Vaccination following a rabbi recommendation				
Disagree	9 (40.9)	18 (22.8)	Reference	0.10
Agree	13 (59.1)	61 (77.2)	0.42 (0.15–1.15)	
Trust in MOH regarding vaccines				
No	7 (29.2)	17 (21.8)	1.47 (0.52–4.14)	0.58
Yes	17 (70.8)	61 (78.2)	Reference	
Having a complementary health insurance				
No	15 (60.0)	14 (17.7)	Reference	<0.001
Yes	10 (40.0)	65 (82.3)	0.14 (0.05–0.39)	
Prefer natural devilry				
No	19 (76.0)	70 (86.4)	Reference	
Yes	6 (24.0)	11 (13.6)	2.00 (0.65–6.13)	0.22
Using epidural anesthesia				
No	15 (55.6)	37 (46.3)	1.45 (0.60–3.56)	0.40
Yes	12 (44.4)	43 (53.8)	Reference	
Opposing vitamin K administration				
No	22 (88.0)	76 (97.4)	Reference	0.09
Yes	3 (12.0)	2 (2.6)	5.18 (0.81–32.9)	
Breastfeeding duration (months)	12.4 (5.3)	12.9 (6.6)	0.98 (0.91–1.06)	0.72
Prefer alternative medicine				
No	12 (57.1)	59 (78.7)	Reference	
Yes	9 (42.9)	16 (21.3)	2.76 (0.99–7.71)	0.08

The total number of cases and controls may be less than 28, and 83, respectively, due to missing data on some variables.

<sup>a</sup> OR (CI): Odds Ratio and confidence intervals. MOH: Ministry of Health.

<sup>b</sup> Household crowding was calculated as the number of persons living in the household divided by the number of rooms in the household. Household crowding was considered high if it was higher than the median level.

The ultraorthodox Jewish communities in Israel and abroad have suffered from frequent outbreaks of vaccine preventable diseases [10–15]. Given the closed nature of this population, exploring the risk factors of vaccines underutilization was always challenging [25]. Applying a culturally sensitive approach we comprehensively studied and documented for the first time the determinants of vaccines under immunization in this community.

This study has several limitations, data on immunizations among subjects from Jerusalem and those who were not located in FHCs were obtained through maternal reports. The

compliance with the survey in Jerusalem was low (~30%), and about 13% of the children who were sampled from Bnei Brak were not located. It is possible that the figures obtained on the vaccination coverage might be slightly overestimated because they derived just from subjects who agreed to be interviewed and those who were successfully located. In addition, we were not always able to distinguish between parental refusals or delay of their child vaccination, since a documentation of these conditions was not always available in the medical records.

**Table 4**  
Multivariate analysis of the risk factors of underutilization of childhood immunizations.

	Adjusted OR (95%CI)	P value
<b>Bnei Brak<sup>a</sup></b>		
No. siblings		
≤6	Reference	
>6	7.26 (2.12–24.89)	0.002
Maternal education		
Academic	4.76 (1.43–15.76)	0.011
Not-academic	Reference	
Religious beliefs against vaccination		
Disagree	Reference	
Agree	7.64 (2.21–26.40)	0.001
The risk of vaccine preventable diseases is low		
Disagree	Reference	
Agree	4.28 (1.35–13.53)	0.013
Trust in MOH regarding vaccines		
No	5.54 (1.40–21.80)	0.014
Yes	Reference	
<b>Jerusalem<sup>b</sup></b>		
Religious beliefs against vaccination		
Disagree	Reference	
Agree	6.91 (1.41–33.83)	0.017
The risk of vaccine preventable diseases is low		
Disagree	Reference	
Agree	4.90 (1.00–24.00)	0.05
Having a complementary health insurance		
No	Reference	
Yes	0.10 (0.02–0.48)	0.017

<sup>a</sup> The variables that were included in the multivariate analysis were maternal education, number of siblings, perceived risk of vaccine preventable diseases, preference of natural immunity over vaccine-induced immunity, holding religious beliefs against vaccines, using epidural anesthesia, and trust in Ministry of Health (MOH) concerning vaccines.

<sup>b</sup> The variables that were included in the multivariate analysis were perceived risk of vaccine preventable diseases, holding religious beliefs against vaccines, attitudes towards vaccines' safety, preference of alternative medicine, opposing vitamin K administration, and having complementary health insurance.

## 5. Conclusions

Large families and mothers with academic education are the risk groups of under-immunization in early childhood in the ultra-orthodox Jewish community. Some of the risk factors are modifiable by means of health education on the risks of vaccine preventable diseases and improving the trust in MOH. The leaders of the ultraorthodox communities could play an important role in such interventions.

## Acknowledgements

The authors thank Mr. Michael Brik, Mr. Yuval Shapira and Mr. Wasef Naamanah for the help in data collection and management.

This study was supported by a grant from the National Institute for Health Research Policy (Grant number 05/49). The study sponsors had no role in the study design, collection of data, analysis and interpretation of results, neither in writing and submitting the manuscript.

*Conflict of interest statement:* All authors declare no conflict of interest.

## Appendix A.

### Perceived risk of vaccine preventable diseases

1. The diseases for which vaccines are given usually are not severe.
2. I do not hurry to vaccinate my children since most children in the population are vaccinated.
3. Outbreaks can propagate to all regions in the country.

4. A disease like measles is usually transient, it is better to get the disease than the risk of the vaccine.
5. Vaccines are not needed anymore, since the diseases for which vaccination os given have vanished.
6. The risk of a vaccine is greater than the risk of the disease.
7. The risk of vaccines is very small.

### Vaccines safety

1. The vaccines that were approved by the MOH are safe.
2. The vaccine against measles is safe and efficient.
3. The information on vaccines' safety is not reliable.

### Preference of natural immunity

1. It is better to acquire immunity by a natural disease.
2. Breastfeeding supplies better protection than vaccines do.
3. It was the good hygiene that led to the reduction in infectious diseases.

### Religious beliefs against vaccines

1. God will protect children; there is no need to vaccinate them.
2. To save your soul, avoid a doctor without faith.
3. Diseases occur due to disrespect to God and not due to under-vaccination.

### Rabbi recommendation

I will not vaccinate my children if the rabbi does not recommend that (the mother was asked to rate her agreement with this single statement).

### Vaccines are traumatic for the child

The mother was asked to rate her agreement with this single statement.

## References

- [1] Center for Disease Control and Prevention. Ten great public health achievements – United States, 1900–1999. *JAMA* 1999;281:1481.
- [2] Amanna I, Slifka MK. Public fear of vaccination: separating fact from fiction. *Viral Immunol* 2005;18:307–15.
- [3] Omer SB, Salmon DA, Orenstein WA, deHart MP, Halsey N. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. *N Engl J Med* 2009;360:1981–8.
- [4] Chen RT, Hibbs B. Vaccine safety: current and future challenges. *Pediatr Ann* 1998;27:445–55.
- [5] Lyren A, Leonard E. Vaccine refusal: issues for the primary care physician. *Clin Pediatr* 2006;45:399–404.
- [6] Gust DA, Strine TW, Maurice E, Smith P, Yusuf H, Wilkinson M, et al. Underimmunization among children: effects of vaccine safety concerns on immunization status. *Pediatrics* 2004;114:e16–22.
- [7] Fiks AG, Alessandrini EA, Luberti AA, Ostapenko S, Zhang X, Silber JH. Identifying factors predicting immunization delay for children followed in an urban primary care network using an electronic health record. *Pediatrics* 2006;118:e1680–6.
- [8] Goodman KJ, Wu JS, Frerichs RR. Compliance with childhood immunizations in Kern County, California. *J Immigr Health* 2000;2:213–22.
- [9] Israel Center for Disease Control. 60 years of health in Israel. Tel Hashomer: Ministry of Health; 2008.
- [10] Muhsen K, Shohat T, Aboudy Y, Mendelson E, Algor N, Anis E, et al. Seroprevalence of mumps antibodies in subpopulations subsequently affected by a large scale mumps epidemic in Israel. *Vaccine* 2011;29:3878–82.
- [11] Anis E, Grotto I, Moerman L, Warshavsky B, Slater PE, Lev B, et al. Measles in a highly vaccinated society: the 2007–08 outbreak in Israel. *J Infect* 2009;59:252–8.
- [12] Stein-Zamir C, Zentner G, Abramson N, Shoob H, Aboudy Y, Shulman L, et al. Measles outbreaks affecting children in Jewish ultra-orthodox communities in Jerusalem. *Epidemiol Infect* 2008;136:207–14.
- [13] Stewart-Freedman B, Kovalsky N. An ongoing outbreak of measles linked to the United Kingdom in an ultra-orthodox Jewish community in Israel. *Eurosurveillance* 2007;12:E070920 1.
- [14] Lernout T, Kissling E, Hutse V, De Schrijver K, Top G. An outbreak of measles in Orthodox Jewish communities in Antwerp, Belgium, 2007–2008: different reasons for accumulation of susceptibles. *Eurosurveillance* 2009;14:15–8.

- [15] Centers for Disease Control and Prevention. Update: mumps outbreak – New York and New Jersey, June 2009–January 2010. *MMWR Morb Mortal Wkly Rep* 2010;59:125–9.
- [16] Gurovich N, Cohen-Kastro E. Ultra-orthodox Jews geographic distribution and demographic, social and economic characteristics of the ultra-orthodox Jewish population in Israel 1996–2001. Central Bureau of Statistics; 2004.
- [17] Israel Central Bureau of Statistics. Characteristics of the ultraorthodox Jewish population; 2010. Available from: [http://www.cbs.gov.il/www/publications/quality\\_religion.xls](http://www.cbs.gov.il/www/publications/quality_religion.xls) (cited September 2010).
- [18] Israel Central Bureau of Statistics. Measurement and estimates of the population of ultra-orthodox Jews. Israel Central Bureau of Statistics; 2011.
- [19] Gust DA, Darling N, Kennedy A, Schwartz B. Parents with doubts about vaccines: which vaccines and reasons why. *Pediatrics* 2008;1224:718–25.
- [20] Wei F, Mullooly JP, Goodman M, McCarty MC, Hanson AM, Crane B, et al. Identification and characteristics of vaccine refusers. *BMC Pediatr* 2009;9:18.
- [21] Waldhoer T, Haidinger G, Vutuc C, Haschke F, Plank R. The impact of sociodemographic variables on immunization coverage of children. *Eur J Epidemiol* 1997;13:145–9.
- [22] Shui IM, Weintraub ES, Gust DA. Parents concerned about vaccine safety – Differences in race/ethnicity and attitudes. *Am J Prev Med* 2006;31:244–51.
- [23] Bardenheier B, Yusuf H, Schwartz B, Gust D, Barker L, Rodewald L. Are parental vaccine safety concerns associated with receipt of measles-mumps-rubella, diphtheria and tetanus toxoids with acellular pertussis, or hepatitis B vaccines by children. *Arch Pediatr Adolesc Med* 2004;158:569–75.
- [24] Salmon DA, Moulton LH, Omer SB, deHart MP, Stokley S, Halsey NA. Factors associated with refusal of childhood vaccines among parents of school-aged children – A case-control study. *Arch Pediatr Adol Med* 2005;159:470–6.
- [25] Rier DA, Schwartzbaum A, Heller C. Methodological issues in studying an insular, traditional population: a women's health survey among Israeli Haredi (ultra-orthodox) Jews. *Women Health* 2008;48:363–81.