Extent, duration and predictors of exclusive breastfeeding in a longitudinal study: adjusting for missing data using an accelerated failure time model and multiple imputation

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DOI: ***10.2427/13008***
Accepted on February 13, 2019

ABSTRACT

Background: The World Health Organization recommends at least 6 months of exclusive breastfeeding (EBF). Longitudinal studies facilitate estimation of EBF duration, but often suffer from loss to follow-up and missing information. The study estimates the prevalence of EBF, duration and predictors of EBF duration while adjusting for missing data using multiple imputation (MI).
Methods: A longitudinal study was conducted on all women giving birth between September 2009-February 2010 in selected hospitals (N=2119). Data on EBF and socio-demographic and other characteristics were collected at birth, and at 2, 6, 12 and 24 months. Information on EBF status and duration was missing for 29%. To deal with missing data, we generated multiple datasets using logistic regression-based MI to impute missing EBF practice, and an accelerated failure time (AFT) model to impute missing duration of EBF. The latter model also identified factors associated with EBF duration.
Results: The observed 64% of women practicing EBF (95%CI; 62%-66%) was adjusted, after imputation, to 62% (95%CI; 60%-65%). After imputation, the estimated median time of EBF among women practicing EBF was 4.9 months. Predictors of EBF duration were stated intention to breastfeed, religious observance, and giving formula milk while in hospital.
Conclusion: Adjusting estimates of EBF practice and duration using MI is feasible and potentially important. Using an AFT model for EBF duration enables the execution of MI in such studies and allows direct interpretation of the impact of various factors on EBF duration.

Key words: Social media, health information, inoculation, family health

INTRODUCTION

The benefits of breastfeeding are well documented in public health research [1]. Breastfeeding reduces morbidity from diarrhea, cough and wheeze, fever and ear infections [2, 3]. Data from the National Maternal and Infants Survey (NMIS) found a dose-response association between breastfeeding during the first 6 months of life and reduced morbidity among infants and babies [4]. Furthermore, breast milk for premature infants reduces the risk of infectious diseases, enhances cognitive development and increases maternal psychological wellbeing [5]. The World Health Organization (WHO) and the American Academy for Pediatrics (AAP) recommend 6 months exclusive breastfeeding (EBF), with no additional food or liquids, followed by continued breastfeeding as complementary food is introduced, with continuation of breastfeeding for one year or longer [1, 6]. Successful breastfeeding depends on multiple factors such as socio-demographic characteristics,[7-10] a psychologically supportive environment,[11] hospital practices,[12] biological factors [8] and the mother's attitudes toward breastfeeding [13].

Ongoing surveillance of breastfeeding practices is necessary to evaluate compliance with national targets. Studies that report rates of EBF are usually based on observational longitudinal studies [10, 12, 14]. However, they often suffer from loss to follow up or lack of response to key questions in a considerable proportion of individuals. In several longitudinal studies the percentage of participants with follow-up information partially or completely missing ranged from 6% to 57% [12, 15-24]. However, despite the wide availability of methods to adjust for such missing data in estimating key parameters, [25] most reports do not attempt any such adjustment. A systematic review that discussed the incidence and duration of breastfeeding in Canada, US, Europe and Australia, listed loss to follow-up as a limitation of those studies and highlighted the importance of additional methodological research to determine the true rate of initiation and duration of breastfeeding [26].

In this longitudinal study we had three main goals: (i) to estimate the prevalence of EBF in Israel; (ii) to estimate the duration of EBF practice in Israel among mothers practicing EBF, and (iii) to identify factors that predict EBF duration in Israel. This paper highlights two special features of our analysis: multiple imputation adjustments accounting for missing follow-up data and use of the accelerated failure time model for identifying factors related to EBF duration.

METHODS

The MABAT National Health and Nutrition Survey of Infants

The MABAT National Health and Nutrition Survey for infants aged 0-2 years was a longitudinal study conducted by the Israel Center for Disease Control, in collaboration with public health services in Israel, during September 2009-June 2012. Data were collected at birth, and at approximately 2 months, 6 months, 12 months and 24 months thereafter [27].

Sampling and study population

The sampling frame included all mothers giving birth in one of 10 major hospitals across Israel, on certain days in September 2009 through February 2010. In Israel, there are 26 hospitals with delivery wards; 10 major hospitals were chosen, representative of the various population groups in Israel, covering approximately 50% of all births. The target number of mothers to be recruited for the study from each hospital was proportional to the number of births in that hospital in 2005. There was no significant change in the distribution of births between 2005 and 2009 (unpublished data). The planned sample number of mothers was 2,000. To reach this number, 2698 women were considered. Women who gave birth to triplets (or more) or delivered prematurely and those who did not intend to stay in the country for the survey period (two years) or did not speak Hebrew or Arabic were excluded. After these exclusions, and the approximately 15% refusals to participate, 2119 women (79.8% of those considered) were interviewed.

Potential participants were given a detailed explanation about the study aims and the time schedule for future interviews, and those who agreed signed an informed consent. The study was approved by the ethics committee in each participating hospital.

Data collection and the study questionnaire

Data on health status and nutrition were collected at birth, 2, 6, 12 and 24 months using structured questionnaires. The first interview was conducted face-to-face in the maternity ward and the subsequent interviews by telephone. Non-response was defined as no contact achieved after 8 attempts.

The first questionnaire included information on the mother's date of birth, date of delivery, population group (Jewish or Arab), religiosity, education, household income, employment status before delivery, and intention to breastfeed. Hospital practices included whether formula milk, pacifier and/or water were offered to the infant in the hospital, and mother's breast contact with the infant during the first 24 hours after delivery.

The follow-up questionnaires were modified according to the infant's age. Women who refused to answer or could not be reached at a certain stage were nevertheless contacted at later stages.

An infant was considered "exclusively breastfed" if he/she received only breast milk for at least one month.

Statistical analysis

Descriptive statistics were produced to describe the study participants. Differences in distribution of characteristics of participants lost to follow-up (n=570), participants who were contacted but did not provide their EBF status (n=52), and participants who reported their EBF status (n=1497) were tested using chi-squared tests (supplementary table: 1). The chi-squared test was also used to compare differences between women who did and did not practice EBF.

To estimate the proportion of women practicing EBF, we assumed that missing data on EBF status were missing at random (MAR), and generated multiple datasets using logistic regression using the fully conditional specification approach [28] with 20 imputations. The logistic regression model included age and education plus only those explanatory variables that had coefficients or (for categorical variables) a global test significant at the 10% level. We estimated the probability of practicing EBF and its standard error in each of the 20 completed data sets (i.e. observed together with imputed values), and combined the results using Rubin's rules [29]. Predicted probabilities of practicing EBF for each woman with missing EBF status served as weights in the analysis of EBF duration.

Women who reported practicing EBF also reported the duration. However, to estimate the EBF duration among all those practicing EBF, we needed also to account for women with unknown EBF status. The process of imputation and analysis is presented in supplementary figure 1.

We first developed an equation linking EBF duration to covariates, using an accelerated failure time (AFT) model [30], applied to the sub-study of women who had reported EBF duration. A log-normal distribution of EBF durations, conditional on the covariates, was chosen, based on the log-likelihood test. The model included only those explanatory variables that had a coefficient or (for categorical variables) a global test that was significant at the 10% level and were not identical to the variables chosen for the logistic regression imputation model. We used the coefficients and residual variance from this model to generate multiple datasets of EBF durations of women with unknown EBF status, generating five completed data sets. We then estimated the EBF duration distribution in those practicing EBF, using the weighted Kaplan-Meier curve by the LIFETEST procedure (SAS 9.4) for each completed dataset, giving women with unknown EBF status a weight equal to their predicted probability of practicing EBF obtained from the first stage of the analysis. Women who reported practicing EBF were given a weight of 1.0. Finally, Rubin's rule was applied to the estimated probabilities of continuing EBF at times that were common to all five completed datasets. The probability of continuing EBF was graphed against time and the quartiles of the EBF duration distribution were calculated.

Whether the missing data were really missing at random (MAR) is unknown. The assumption seemed reasonable for those 570 women who were lost to follow-up. However, the 52 women who were contacted but gave no information about EBF may have been less likely to have breastfed exclusively. Therefore, we conducted a sensitivity analysis, where we assumed that these 52 women did not practice EBF, and used multiple imputation only for the 570 women lost to follow-up.

The factors associated with EBF duration were identified through the AFT model. Using the coefficients from this model, each factor's association can be expressed as a multiplicative effect on EBF duration.

Analyses were conducted in SAS 9.4, with the logistic regression implemented using the FCS command of the MI procedure, and the AFT model executed by the LIFEREG procedure.

RESULTS

Socio-demographic characteristics

2119 women who met the inclusion criteria were recruited to the study; the number of women who participated in the 2m, 6m, 12m and 24m interviews were 1319, 960, 890 and 875 respectively. The mean age of participants was 32.5y (STD =5.5, range 20-59). Ninety eight percent of participants were married. Fifty percent were Jewish and 50% were Arab. Nineteen percent defined themselves as "religious", and close to one-third had an academic degree. Almost 8% were current smokers, and another 11% were past smokers. Mean BMI after delivery was 32.1 (STD=18.4) (Table 1).

Practices in hospital

For 98% of participants, infants were not given water in the hospital ward, for 71%, infants were given formula, and for 44%, infants were given a pacifier in the hospital. Almost 80% of participants breastfed their infants during the first 24 hours, and 60% had breast contact immediately after delivery. Seventy four percent of participants had vaginal deliveries. About 94% of participants stated their intention to breastfeed (Table 1).

Supplementary Table 1 compares the baseline demographic characteristics and hospital practices among the 1497 participants that later reported EBF status, 570 participants who were lost to follow-up and 52 participants who were contacted but gave no EBF information. Participants who reported EBF status had similar characteristics to those lost to follow-up, except that loss to follow-up rates differed by hospital. The 52 participants who were contacted but gave no EBF information were more likely to be secular (40.4% versus 26.2% who reported EBF status and 22.5% lost to follow-up), and have an academic degree (71.2%

TABLE 1. Demographic characteristics, health behaviors and hospital parameters of study population (n=2119)

		Frequency (n, %)
Demographic characteristics		
Age in 2012	mean (std) Min-max	32.3[5.5] [20-59]
	Missing (n)	28
Marital status	Married or lives with a partner	2073(98%)
	Single/divorced/widow /lives by herself	41(2%)
	Missing (n)	5
Ethnicity	Jews and others	1060(50%)
	Arabs	1043(50%)
	Missing(n)	16
Religious observance	Secular	541(26%)
	Traditional	968(46%)
	Religious	398(19%)
	Ultra-orthodox	189(9%)
	Missing (n)	23
Education	No academic degree	1,410 (67%)
	Academic degree	684(33%)
	Missing (n)	26
Parity	Primiparous	487(25%)
	Multiparous	1472 (75%)
Income (USD)	<=1,500	428(39%)
	1,501-3500	557(51%)
	>3,501	111(10%)
	Missing (n)	1023
Employed before delivery	Yes	815(62%)
	No	504(38%)
	Missing (n)	
Self employed	Yes	57(7%)
	No	761(93%)
	Health behaviors	
Current smoker	Yes	102(8%)
	No	1217(92%)
Past smoker	Yes	149(11%)
	No	1170(89%)
BMI after the delivery	Mean (std)	32.1(18.4)
	Min-Max	[18.3-48]

versus 30.4% and 43.5% respectively), and were less likely to have stated an intention to breastfeed (71.2% versus 93.5% and 92.9% respectively) or to have undergone cesarean delivery (56.8% versus 73.9% and 76.1%).

Demographic characteristics of women who did and did not practice EBF

Women practicing EBF were more likely to have stated an intention to breastfeed (98.9% versus 83.7%), and to have breastfed their infants in the first 24 hours (76.7% versus 56.2%). Their infants were less likely to have received formula milk in the hospital (52.2%

TABLE 1 (CONTINUED). Demographic characteristics, health behaviors and hospital parameters of study population (n=2119)

		Frequency (n, %)
Demographic characteristics		
Hospital practices		
Hospital	1	202 (9.5%)
	2	240(11.3%)
	3	219(10.3%)
	4	230(10.9%)
	5	314(14.8%)
	6	156 (7.4%)
	7	99 (4.7%)
	8	161(7.6%)
	9	395 (18.6%)
	10	103 (4.9%)
Infant received water in the hospital	Yes	21(2%)
	No	1189(98%)
Formula in the hospital	Yes	916(71%)
	No	377(29%)
Pacifier in the hospital	Yes	588(44%)
	No	735(56%)
Breastfeeding in the first 24 hours	Yes	1055(80%)
	No	268(20%)
Delivery		
Mode of delivery	Vaginal	1548(74%)
	Cesarean	546(26%)
	Missing (n)	5
Breastfeeding		
Intention to breastfeed	Yes	1966(94%)
	No	120(6%)
	Missing	33

versus 71.8%) (Table 2). The proportion of women who practiced EBF varied between hospitals.

Prevalence of exclusive breastfeeding

The observed proportion of women reporting EBF was 64.0% [95%CI: 61.5%-66.4%] (case-complete analysis). After multiple imputation adjustment, the estimate was somewhat lower [62.5%, 95%CL: 59.8%-65.1%]. In the sensitivity analysis, assuming that the 52 women who gave no EBF information did not practice EBF, the estimated proportion practicing EBF declined further to 60.4% (95%CL: 57.4%-63.4%).

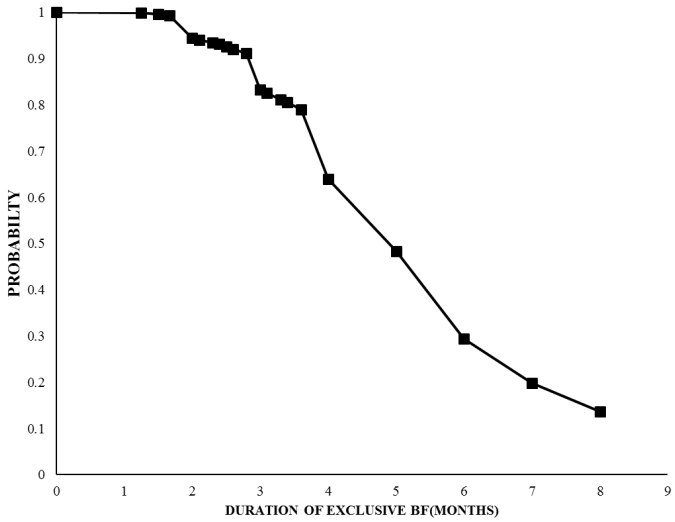
The observed median EBF duration among mothers practicing EBF was 4.5 months, the lower quartile was 3.0 months, and the upper quartile 6.0 months. After multiple imputation adjustment, the estimated median was 4.9 months, the lower quartile was 3.7 months, and the upper quartile was 6.4 months. Figure 1 displays the adjusted distribution of duration of EBF. Among women practicing EBF, 29.4% were estimated to continue at least 6 months.

To calculate the distribution of duration of EBF among all mothers, one needs to take into account those who do not practice EBF, estimated to be (100-62.5) % = 37.5% of mothers. Thus, among all mothers, the estimated percentage continuing to practice EBF for at least 6 months is .625 x 29.4% = 18.4%.

Predicting factors associated with duration of exclusive breastfeeding

Table 3 presents the factors that predicted the duration of practicing EBF, as determined by the AFT model. Women with an academic degree compared

FIGURE 1. Distribution of the duration of EBF among mothers practicing EBF. The graph shows the probability of practicing EBF for at least the duration shown on the x-axis.



to those with none were estimated to increase their duration of EBF by 7% (Time ratio (TR) =1.07; 95%CI: 0.99-1.15). Compared to "ultra-orthodox" women, other women were estimated to exclusively breastfeed for 11-12% less duration. Intention to breastfeed was a strong predictor and those who stated such were estimated to have an approximately 90% greater duration of EBF than those who did not (TR=1.93; 95%CI: 1.29-2.89). Mothers of infants who were given formula or pacifiers in the hospital were estimated to have an approximately 10% decreased duration of EBF.

DISCUSSION

In this study we present results from a longitudinal study relating to the prevalence and duration of EBF in Israel. Our estimate of the proportion of mothers continuing EBF for 6 months (18.4%) is far below the target of 50% set by the WHO[31], and is similar to the US national estimate for 2014 of 18.8% [32], and higher than those reported from Australia and Austria [33,12].

As far as we know, this is the first longitudinal study of breast feeding practice on a national level which has adjusted the estimates of prevalence and duration of EBF for the missing information occurring on follow-up. In our case, the adjustments had a modest impact on the estimates of prevalence and duration, in particular reducing the estimate of prevalence from 64% to 62%, or, in a sensitivity analysis, to 60%. The small change in the estimate following adjustment may have been because the main reason for our missing information was loss to follow-up and not missing information among those who were interviewed. We showed that the distribution of factors associated with breastfeeding among those lost to follow-up was similar to among those whom we did contact (e.g education level and religious observance); however, they differed in hospital practices (i.e. giving formula milk or water to the infant in hospital). Those mothers who were contacted but declined to answer questions about EBF did appear to have different characteristics from those who responded. Had the frequency of such non-response been larger than the 2.5% observed, then the adjustment would have created a larger change in the estimated prevalence of EBF.

The literature indicates that our study, where the percentage of women with no follow-up information was as high as 29%, was not unusual in its "drop-out" rate. In other studies drop-out rates ranged from 6.5% to 57% [12, 15, 19-24] with an average of 31.8% . It is possible that the drop-out in some of these studies was dictated by factors more closely related to EBF than in ours, in which case the potential for bias in an adjusted estimate would be much greater.

Statistical methods of adjusting estimates for missing data are important for avoiding the biases caused by ignoring missing data. There is more than one method of adjustment. The two that are most popular are multiple imputation [34] and inverse probability weighting [25]. Seaman and White (2013) discuss the choice between the two methods and point out that multiple imputation uses the information in the data more efficiently and on theoretical grounds is to be preferred to inverse probability weighting. We followed this recommendation [35].

Our findings relating to the factors predicting longer duration of EBF were consistent with those of other studies[8, 23] [36]. Religiosity was found to be a predictive and

TABLE 2. Differences between women who did and did not practice EBF (N=1,497 women who reported information on EBF)

		Did not practice EBF (n=539)	Practiced EBF (n=958)	Chi-square	P-value
Age	Mean (std)	32.3(5.4)	32.3(5.4)	t-statistic=0.00	0.99
Marital status				4.05	0.13
	Married or lives with a partner	531(98%)	943(98%)		
	Single/divorced/ widow /lives alone	6(1%)	15(2%)		
	Missing	2(0.4%)	0 (0%)		
Ethnicity				1.03	0.31
	Jews and others	279(52%)	522(55%)		
	Arabs	260(48%)	436(45%)		
Religious observance				16.9	0.02
	Secular	145(27%)	247(26%)		
	Traditional & other	252(47%)	409(43%)		
	Religious	108(20%)	180(19%)		
	Ultra–orthodox	29(5%)	113(12%)		
	Missing	5(1%)	9(1%)		
Education				0.019	0.36
	No academic degree	365(68%)	664(69%)		
	Academic degree	167(31%)	288(30%)		
	Missing	7(1%)	6(1%)		
Delivery method				20.25	<0.001
	Vaginal	365(68%)	740(77%)		
	Cesarean	171(32%)	218(23%)		
	Missing	3(0.6%)	0(0%)		
Breastfeeding in the first 24 hours				79.2	<0.001
	Yes	303(56%)	735(77%)		
	No	148(28%)	107(11%)		
	Missing	88(16%)	116(12%)		
Income (USD)				9.8	0.02
	<=1,500	135(25%)	284(30%)		
	1,501-3,500	205(38%)	336(35%)		
	>3,501	29(5%)	79(8%)		
	Missing	170(32%)	259(27%)		
Hospital				31.66	<0.001
	1	46(8.5%)	108(11.3%)		
	2	51(9.5%)	121(12.6%)		
	3	66(12.2%)	94(9.8%)		
	4	58(10.8%)	117(12.2%)		
	5	111(20.6%)	118(12.3%)		
	6	51(9.5%)	72(7.5%)		
	7	28(5.2%)	47(4.9%)		
	8	29(5.4%)	84(8.8%)		
	9	73(13.5%)	138(14.4%)		
	10	26(4.8%)	59(6.2%)		
Intention to breastfeed				133.4	<0.001
	Yes	451(84%)	948(99%)		
	No	70(13%)	5(0.5%)		
	Missing	18(3%)	5(0.5%)		
Formula in the hospital				5.14	<0.001
	Yes	387(72%)	500(52%)		
	No	62(12%)	314(33%)		
	Missing	90(17%)	144(15%)		
Pacifier in the hospital				10.76	0.004
	Yes	219(41%)	351(37%)		
	No	232(43%)	491(51%)		
	Missing	88(16%)	116(12%)		

TABLE 3. Predicting factors for the duration of EBF: Time Ratios (TR) from AFT model in the case-complete analysis and after partial or complete imputation

		Complete cases (n=1497)		Partially imputed* (n=2067)	Fully imputed** (n=2119)
		TR (95%CI)	P.value	TR (95%CI)	TR (95%CI)
Age		1.002 (0.996-1.008)	0.51	1.001 (0.996-1.007)	1.001 (0.996-1.007)
Population group	Arabs	1.00 (0.91-1.10)	>0.99	1.00 (0.91-1.09)	1.00 (0.91-1.09)
	Jews	Ref		Ref	Ref
Religious observance	Secular	0.89 (0.79-1.01)	0.07	0.89 (0.80-1.00)	0.90 (0.79-1.01)
	Traditional & other	0.89 (0.78-1.01)	0.06	0.88 (0.76-1.01)	0.88 (0.76-1.02)
	Religious	0.88 (0.77-1.00)	0.06	0.88 (0.76-1.01)	0.88 (0.76-1.01)
	Ultra-orthodox	Ref		Ref	Ref
Education	Academic degree	1.07 (0.99-1.15)	0.09	1.08 (1.01-1.15)	1.08 (1.02-1.14)
	No academic degree	Ref		Ref	Ref
Hospital	1	0.95 (0.80-1.15)	0.63	0.94 (0.78-1.14)	0.93 (0.78-1.12)
	2	1.01 (0.85-1.20)	0.91	1.02 (0.84-1.22)	1.01 (0.85-1.19)
	3	1.03 (0.86-1.24)	0.73	1.03 (0.86-1.22)	1.02 (0.86-1.20)
	4	1.02 (0.85-1.23)	0.81	1.00 (0.83-1.21)	1.00 (0.84-1.18)
	5	0.88 (0.75-1.03)	0.12	0.87 (0.74-1.01)	0.86 (0.74-1.01)
	6	0.93 (0.78-1.11)	0.41	0.92 (0.76-1.12)	0.91 (0.76-1.10)
	7	0.87 (0.72-1.06)	0.16	0.88 (0.73-1.06)	0.87 (0.72-1.06)
	8	0.95 (0.80-1.13)	0.54	0.94 (0.79-1.12)	0.93 (0.79-1.10)
	9	1.10 (0.93-1.30)	0.28	1.07 (0.92-1.24)	1.07 (0.92-1.24)
	10	Ref		Ref	Ref
Intention to breastfeed	Yes	1.93 (1.29-2.89)	0.001	1.91 (1.35-2.70)	1.89 (1.34-2.66)
	No	Ref		Ref	Ref
Formula in hospital	Yes	0.93 (0.86-1.00)	0.041	0.93 (0.86-1.00)	0.92 (0.86-0.99)
	No	Ref		Ref	Ref
Pacifier in the hospital	Yes	0.90 (0.84-0.97)	0.005	0.90 (0.84-0.97)	0.90 (0.83-0.97)
	No	Ref		Ref	Ref

** Imputes EBF duration times for those lost to follow-up (570)*

*** Imputes EBF duration times both for those lost to follow-up (570) and for refusals (52)*

promoting factor for increased duration of EBF; ultra-orthodox women reported longer duration of EBF compared with other women, which may be related to the different lifestyle of the former, and the fact that they are less engaged in the workforce compared to other Israeli women. In addition, the limited income of the ultra-orthodox community may be a further explanatory factor for the reduced usage of formula milk; as can the practice of BF as a natural method for spacing between pregnancies in a community where birth control is generally not practiced [37, 38].

Hospital practices whereby formula milk and/or pacifiers are given to the infant were negatively associated with duration of EBF (P<0.0001) and may be seen as one of the barriers to increased duration of EBF. These results are consistent with the current literature 33, 36, 39]. For example, an Italian study that was

conducted among mothers within one month of delivery found in-hospital formula supplementation and pacifier use to be significant predictors of shorter exclusive breastfeeding duration [17]. Similarly, a Canadian study conducted on primiparous mothers found that in-hospital supplementation accounted for cessation of EBF is before 6 months [40]. An Indonesian study reported that receiving milk supplements from midwives at hospital discharge encouraged mothers to stop EBF [36].

Mother's intention to breastfeed was the most important predictor for increasing the duration of EBF (by 50%). This finding is in accordance with the "Theory of Reasoned Action", which states that an individual's intentions are the main driver for performing a specific behavior [41]. Our results are also consistent with previous studies showing that mothers' intentions and attitudes are stronger predictors than socio-demographic factors [42].

A major strength of the current study was its large national sample size, which yielded precise estimates of EBF practice and duration and identification of predictive factors. Additionally, this study was able to address and overcome the limitation of considerable missing data, common to many longitudinal studies of breast feeding, by employing advanced statistical methods including multiple imputation, AFT models and sensitivity analysis, which enables the estimation of robust adjusted estimates.

A limitation of the survey design was that it did not entail a completely defined sampling plan. Rather, 10 of the total 26 hospitals in Israel that were judged to provide a representative sample of births in Israel were chosen and births occurring on randomly specified days were sampled. This scheme did not provide sampling weights that are often used in statistical analysis to provide improved estimates in national surveys. Since such sampling weights generally provide adjustment also for survey non-response, it was doubly important that in their absence we apply multiple imputation to account for our missing data. Based on the assumption that the chosen ten hospitals did indeed provide a representative sample, we believe that the results provided in this paper do provide an accurate picture of exclusive breast feeding practice in Israel, among Hebrew or Arabic-speaking mothers giving birth non-prematurely to single or twin babies.

CONCLUSION

Our findings estimate that rates of EBF for at least six months among Israeli women are much lower than the international guidelines. National educational programs should be implemented to promote longer duration of exclusive breastfeeding, especially targeting populations that are likely to stop breastfeeding earlier.

In view of our finding that the woman's intention to breastfeed is the strongest predictor of increased duration of breastfeeding, Israeli women in general need to be further enlightened and prepared regarding the benefits of breastfeeding in general and EBF in particular. Further modifiable risk factors are hospital practices and policies, which need to undergo changes with respect to the widespread use of formula milk and pacifiers.

Abbreviations:

EBF: Exclusive Breastfeeding
MAR: Missing at Random
MI: Multiple imputation
AFT: Accelerated Failure Time
TR: Time Ratio
95%CI:95% Confidence Interval

Acknowledgment

Special thanks to Mrs. Tal Shimony and Mrs. Lesley Nitzan for providing the data set.

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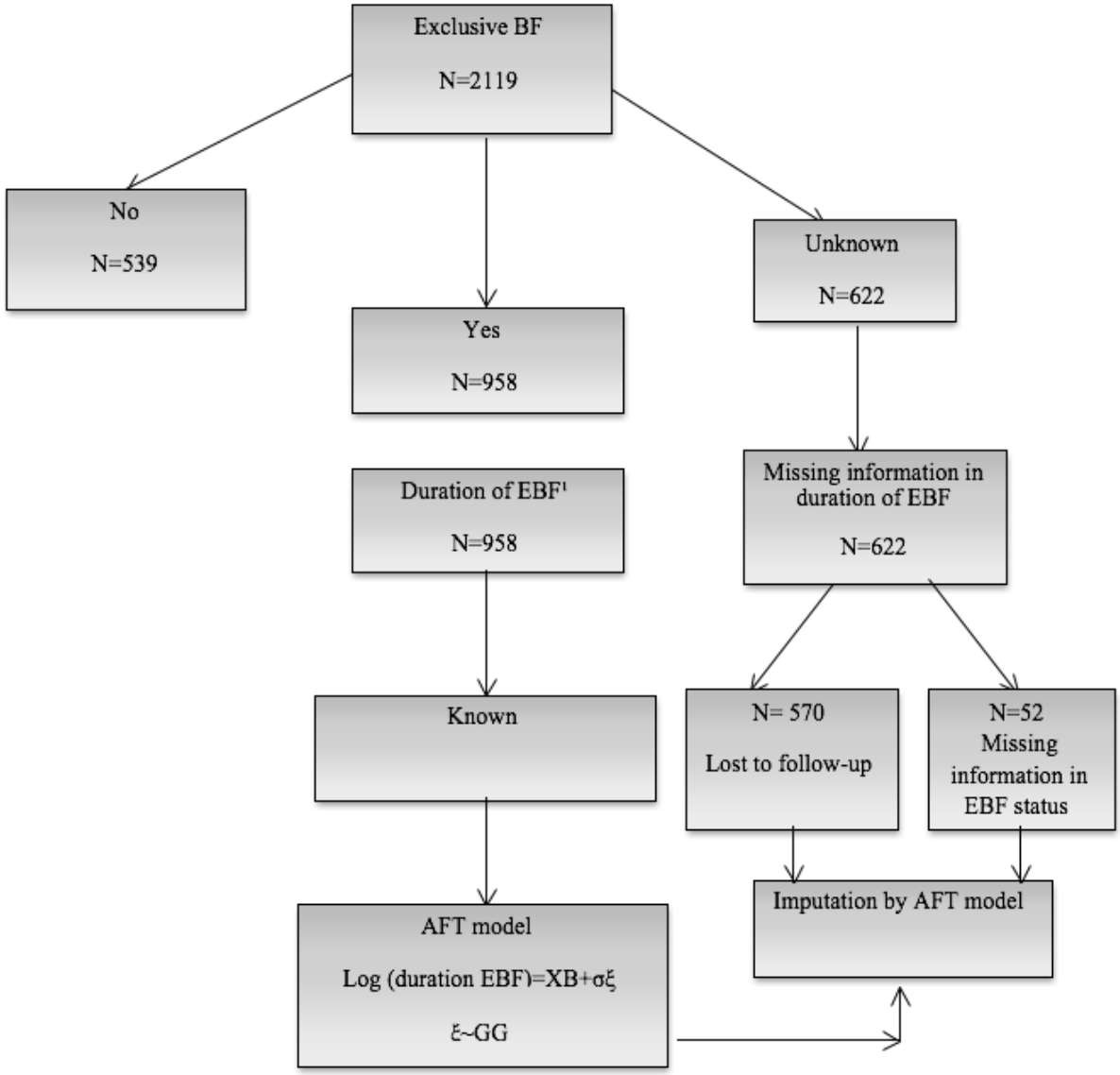
SUPPLEMENTARY TABLE 1. Differences in characteristics of participants lost to follow-up, those who did not report EBF status and those who did report EBF status

		Missing (n=52)	Lost to FU[1] (n=570)	Stayed (1497)	P.value
Ethnicity					P<0.001
	Arabs	18(35%)	331(58%)	696(47%)	
	Jews and others	34(65%)	239(42%)	801(54%)	
Religious observance					P=0.05
	Secular	21(40%)	128(23%)	392(26%)	
	Traditional &other	21(40%)	286(50%)	661(44%)	
	Religious	7(14%)	103(5%)	288(19%)	
	Ultra–orthodox	2(4%)	45(8%)	142(10%)	
	Missing	1(2%)	8(1%)	14(1%)	
Education					P<0.001
	Academic degree	15(71%)	248(44%)	455(30%)	
	No academic degree	37(3%)	309(54%)	1029(69%)	
	Missing	0(0%)	13(2%)	13(0.9%)	
Income (USD)					P<0.001
	<=1,500	9(17%)	0(0%)	419(28%)	
	1,501-3,500	16(31%)	0(0%)	541(36%)	
	>3,501	3(6%)	0(0%)	108(7%)	
	Missing	24(2%)	570(100%)	429(29%)	
Hospital					P<0.001
	1	8(15.4%)	40(7.0%)	154(10.3%)	
	2	4(7.7%)	64(11.2%)	172(11.5%)	
	3	8(15.4%)	51(9.0%)	160(10.7%)	
	4	3(5.8%)	52(9.1%)	175(11.7)	
	5	5(9.6%)	80(14.0%)	229(15.3%)	
	6	5(9.6%)	28(4.9%)	123(8.2%)	
	7	6(11.5%)	18(3.2%)	75(5.0%)	
	8	2(3.9%)	46(8.1%)	113(7.6%)	
	9	7(13.5%)	177(31.0%)	211(14.1%)	
	10	4(7.7%)	14(2.5%)	85(5.7%)	
Intention to breastfeed					P<0.001
	Yes	37(71%)	530(93%)	1399(94%)	
	No	13(25%)	32(6%)	75(5%)	
	Missing	2(4%)	8(1%)	23(2%)	
Formula in the hospital					P<0.001
	Yes	28 (54%)	1(0.1%)	887(59%)	
	No	1(2%)	0(0%)	376(25%)	
	Missing	23(44%)	569(99%)	234(15%)	
Pacifier in the hospital					P<0.001
	Yes	17(33%)	1(0.1%)	570(38%)	
	No	12(23%)	0(0%)	723(48%)	
	Missing	23 (44%)	569(99%)	204(14%)	
Delivery methods					P=0.003
	Vaginal	22(42%)	135(24%)	389(26%)	
	Cesarean	29(56%)	434(76%)	1105(74%)	
	Missing	1(2%)	1(0.2%)	3(0.2%)	
Water in hospital					P<0.001
	Yes	1(2%)	0	20(1%)	
	No	22(42%)	0	1167(78%)	
	Missing	29(56%)	570(100%)	310(21%)	

[1] *LFU: Loss to follow-up*

SUPPLEMENTARY FIGURE 1. Diagram of the imputation process



[1]*EBF: Exclusive Breastfeeding*