ORIGINAL ARTICLE

Factors Affecting Exclusive Breastfeeding, Using Adaptive LASSO Regression

Najmeh Maharlouei[1], MD; Amirhosein Pourhaghighi[2], Medical student; Hadi Raeisi Shahraki[3], PhD; Dariush Zohoori[4], MD; Kamran B. Lankarani[1], MD

[1]Health Policy Research Center, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran;
[2]Medical Students' Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran;
[3]Department of Biostatistics, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran;
[4]Shiraz Medical School, Shiraz University of Medical Sciences, Shiraz, Iran

Corresponding author:
Kamran B. Lankarani, MD; Health Policy Research Center, Building No. 2, 8th Floor, Medical School, Zand Avenue, Postal code: 71348-45794, Shiraz, Iran
Tel\Fax: +98 71 32309615; **Email:** lankarn@sums.ac.ir

Received: 15 January 2018 **Revised:** 16 April 2018 **Accepted:** 28 April 2018

Abstract

Background: Exclusive breastfeeding (EBF) in the first six months of the life can significantly improve maternal and children health, and it is especially important in low- and middle-income countries. We aimed to determine the factors affecting EBF duration in a sample of Iranian infants.

Methods: This prospective study was conducted between April 2012 and October 2014 in Fars, Iran. Women (N=2640), who had given birth to healthy term infants were categorized into EBF versus non-EBF groups. Demographic information from mothers and infants, medical and drug history, and pregnancy related factors were compared between the two groups. Multivariable analysis was performed using Adaptive Lasso regression. $P<0.05$ was considered significant.

Results: The mean duration of EBF was 4.63±1.99 months. There was an inverse association between the mother's educational level and duration of EBF ($P<0.001$). Also, we found that mothers who were housewives had a significantly longer duration of EBF (4.68±1.97) compared to mothers with either part-time (4.21±2.01) or full-time jobs (4.02±2.12) ($P<0.001$). By eliminating the redundant factors, the proposed multivariable model showed the infant's weight gain during EBF, singleton/multiple pregnancies, maternal perception of quantity of breast milk, post-partum infection, use of pacifier, neonate's irritability, birth place and mother's full-time job as the most important factors affecting the duration of EBF. Twin pregnancies, post-partum infection, cesarean section by maternal request, use of a pacifier and irritability in the neonatal period significantly reduced the duration of EBF.

Conclusion: Health policy-makers should promote EBF programs among the educated as well as working mothers in order to positively affect the community's health status.

Keywords: Determinants, Exclusive breastfeeding, Iran, Lactation

Please cite this article as: Maharlouei N, Pourhaghighi AH, Raeisi Shahraki H, Zohoori D, Lankarani KB. Factors Affecting Exclusive Breastfeeding, Using Adaptive LASSO Regression. IJCBNM. 2018;6(3):260-271.

Introduction

Exclusive breastfeeding (EBF) in the first six months of life is very important for the health of both the mother and their infants.[1] EBF reduces morbidity[2] and total mortality of the infants in the first year of life,[3] including diarrhea, infections, and allergic reactions.[4] Moreover, EBF decreases the risk of obesity in childhood[5] as well as disease risk including hypertension later in life.[6] Health benefits of lactation also extend to the mothers; it reduces the risk of diabetes,[7] and premenopausal breast and ovarian cancer.[8, 9] In addition to these beneficial health effects of EBF which reduce total healthcare costs, the money saved from not having to buy formula could also reduce the total family and social expenditure.[10]

Willingness to breastfeed and successfully carry out EBF is multifactorial.[11] Reviews indicate that effective strategies include close mother-baby skin contact, pumping breast milk, as well as educational efforts to improve the mothers' and medical staff's knowledge regarding breast feeding.[12, 13] Baby-friendly accreditation strongly influences breastfeeding effectiveness in infants in neonatal care units.[13] Moreover, studies have revealed that maternal factors as maternal employment,[14, 15] higher education level,[16] smoking during pregnancy, intimate partner violence or lack of partner support, pre-existing health problems,[17] breast complications during breastfeeding,[18, 19] and the use of assisted delivery[17] negatively affect the duration of EBF. Also, younger mothers,[17] specifically teenage mothers,[20] those who have had cesarean section,[15, 16] as well as those who had postpartum depression[20] or perceived breast milk inadequacy[16] reported shorter duration of EBF. While using bottle feeding decreases the duration of EBF,[19] the impact of pacifier is not known.[18, 20]

Reviews have reported that studies evaluating only a limited number of factors may report flawed results and multivariate analysis in large-scale studies are more reliable.[21] We, also, found no published study from Iran evaluating determinants of EBF in a cohort study. Furthermore, in a recently published meta-analysis on determinants of EBF, the authors mentioned that cohort studies should be conducted for drawing robust casualty relation.[22] Hence, we carried out this prospective study to determine the factors affecting EBF duration in a sample of Iranian infants.

Materials and Methods

This cohort study was conducted during April 2012 and October 2014 in Fars, Iran. Eligible participants were mothers who had participated in the study conducted by the first author (N. M.).[23] In the aforementioned study, the researchers asked pregnant mothers with gestational age of 20th to 30th weeks, who had attended obstetric clinics in Fars Province, to participate in a cohort study designed to monitor the determinants of children's growth and development. Therefore, the study was explained to eligible mothers and if they signed an informed consent, they were included in the study. Then, we trained them to write down every detail regarding their health issues as well as their baby's in the notebook given to them. Considering the estimated date of delivery of each mother, we called them 2 and 6 months after giving birth to their children. Those who did not answer their phone for three times were reluctant to participate, or had not written down the details in the aforementioned notebook were excluded.

Participants were informed of the rationale for the surveys and confidentiality of their responses. Also, they were reassured that they did not have to answer the questions if they did not feel comfortable to do so. The protocol of the study was approved by the ethics committee of Health Policy Research Center in the Fars province, Shiraz University of Medical Sciences (number: HP00101222).

We used checklists designed based on the opinions of the expert team consisting of pediatricians, a community medicine specialist, and a health policy maker. Also, we added the items mentioned in the literature as determinants and confounders of infants'

feeding. The checklists were composed of recorded demographic information asked during pregnancy, including the mothers' and their husbands' age, educational level, occupation, properties and family wealth, and ethnicity. In addition, we asked the mothers about the total number of pregnancies, whether the current pregnancy was planned or not, the desired delivery mode for the current pregnancy (vaginal or cesarean section), history of abortion(s) and stillbirth.

The second phase took place eight weeks after delivery; the mothers were contacted by telephone and asked about the actual mode of delivery and if they themselves or their neonate had experienced any complications, as well as about the neonate's feeding type. If breast feeding had not started with breast milk, we categorized the baby in the group of non-EBF babies. All subgroups, either exclusive or non-exclusive breastfed infants, were included in data analysis. Furthermore, we asked questions about the baby's birth place (hospital or maternity center), singleton or multiple pregnancies, number of months the mother had maternity leave, infant's sex, birth weight, length, head circumference, and where the infant was taken care of immediately after birth (beside the mother, in a nursery or in neonatal intensive care unit). The neonate's general condition included skin color and respiration at birth, presence of any congenital malformations and the infant's irritability in the neonatal period. Regarding breastfeeding history, we asked about the time of starting breastfeeding and duration of EBF, whether she had received any instructions regarding breastfeeding, and proper weight gain of the infant. In addition, we collected data on postpartum morbidities, as well as smoking during lactation.

The third phase took place by means of an additional telephone interview when infants were 7 months old. At that time, we asked about the duration of EBF, current type of feeding, infants' weight gain during breastfeeding, use of pacifier during breastfeeding, and multivitamin administration to the infant. We also asked about the duration of maternity leave, the type of mother's job (part time or full time), the use of medication by mother which resulted in cessation of breastfeeding, and smoking during lactation. Furthermore, we asked if the baby had developed atopic dermatitis, respiratory problems including reactive airway disease. As almost all participants were not familiar with medical terms, the interviewers asked the mothers questions about the symptoms of each disease in simple words. Hence, babies were considered positive for each disease if the diagnosis was confirmed by at least one physician. Also, we asked the mothers to tell us the information on weight, height and head circumference according to what has been written in the baby's Health Card. Therefore, we included those participants who had answered our questions in all three steps.

For determining the participants' socioeconomic status (SES), principle component analysis was used. Variables considered in analysis were occupation and education level of mothers and their husbands, household's properties and wealth. Considering the percentiles of SES, we divided the participants into high (SES score upper 75th percentile), moderate (SES score between 25th to 75th percentiles) and low (SES score under the 25th percentile) SES.

For all categorical factors considered in the analysis, mean duration of EBF was first compared by independent t-test for binary categories, and by Analysis of Variance (ANOVA) for groups of three or more. The final model produced by Adaptive Lasso regression is a parsimonious model that includes only the factors with non-zero coefficients. Adaptive Lasso performs simultaneous estimation and variable selection which is appropriate in the presence of a large number of variables. In our regression model, duration of EBF was a dependent variable and all of the other factors (approximately 60) were considered as independent variables. Also, the amount of penalty was estimated using 5-fold cross validation technique.

All the statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), version, and *parcor* package in R.3.1.2 software. P value less than 0.05 was considered significant.

Results

At first, 6921 pregnant mothers were interviewed. However, two months after delivery 4126 mothers, and sixth months after delivery 2640 mothers answered the telephone or were willing to participate. The mean age of the 2640 participants who had completed all the three steps of the study was 26.97±4.97 years and the mean maternal age at marriage was 21.34±4.06 years. As to ethnicity, most of them were Fars (1912; 72.42%) and 1689 (63.98%) were of a middle socio-economic status; 1024 (38.79%) participants gave birth to their children via normal vaginal delivery (NVD) and 1337 (50.64%) via cesarean section(s), while 279 (10.57%) participants had experienced both NVD and cesarean section in their previous deliveries. Also, the mean number of living children was 1.64±0.88.

Mean duration of EBF was 4.63±1.99 months. None of the newborns was classified as non-exclusively breastfed, as even those newborns (128; 4.85%) who were labeled as nil per os (NPO) were fed on their mother's breast milk after feeding was started for them. Maternal age was negatively correlated with duration of EBF ($r=-0.08$, $P<0.001$). Our results showed a statistically significant association between the mothers' educational level and duration of EBF ($P<0.001$); the mothers' higher education level resulted in the shorter duration of EBF. Also, mothers who were homemaker reported the longest duration of EBF ($P<0.001$). Mothers whose ethnicity was reported as Turk had the longest EBF duration (5.18±1.61 months) which was significantly longer than other ethnicities ($P<0.001$). Also, those mothers who had chosen NVD for giving birth to their babies, in the current pregnancy as well as the previous ones, reported longer duration of EBF ($P<0.001$). Other factors including SES, positive history of primary and secondary infertility, and presence of abnormal children (if any) were not statistically related to duration of EBF. Detailed information on each variable is presented in Table 1.

We compared the duration of exclusive breastfeeding in various subgroups as shown in Table 2. Most of the variables were statistically associated with duration of EBF, including neonates' birth place (maternity center versus hospital; $P<0.001$), number of fetuses in the current pregnancy (single versus twin/triple pregnancy; $P<0.001$), type of delivery (NVD versus cesarean section; $P<0.001$), type of cesarean section (emergency versus planned; $P<0.001$), and type of anesthesia used during cesarean section (general anesthesia versus local anesthesia, $P<0.001$). Also, mothers who found their baby irritable, they had significantly ($P=0.007$) more tendency toward discontinuing EBF as they believed that their breast milk was insufficient to keep the baby full. Furthermore, neonates who were kept beside their mother since after birth had significantly ($P=0.002$) longer duration of EBF. Other neonatal factors including neonates' sex, skin color, movement of extremities after birth and neonatal morbidities such as neonatal jaundice, convulsion, infection, and congenital anomalies were not associated with duration of EBF. Among the reported maternal postpartum morbidities, postpartum infection was the only morbidity which resulted in significantly shorter duration of EBF ($P=0.001$). (Table 2)

According to our study, the sooner breastfeeding was started, the longer duration of EBF was reported ($P<0.001$). The factors which significantly enhanced the duration of EBF were the mothers' previous experience of breastfeeding ($P=0.008$), duration of maternity leave ($P=0.001$), and being trained regarding benefits of breastfeeding and correct positions ($P=0.02$). However, some factors inversely affected the duration of EBF, including using pacifier ($P<0.001$), giving water to infants in the first 6 months of life ($P<0.001$), mothers'

Table 1: Comparison of the duration of exclusive breastfeeding based on maternal demographic and obstetric history

Characteristics	Subgroups	N (%)	Duration of exclusive breastfeeding, (month) Mean±SD	P value
Mother's educational level	Under high-school	1028 (38.94)	4.84±1.89	<0.001*
	High-school graduate	978 (37.05)	4.54±2.02	
	Undergraduate degree	610 (23.10)	4.43±2.05	
	Postgraduate degree	24 (0.91)	4.31±1.98	
Husband's educational level	Under high-school	1166 (44.17)	4.78±1.91	0.003*
	High-school graduate	943 (35.72)	4.53±2.02	
	Undergraduate degree	481 (18.22)	4.44±2.08	
	postgraduate degree	50 (1.89)	4.56±1.83	
Mother's job status	Housekeeper	2391 (90.57)	4.66±1.98	0.03**
	Employed	249 (9.43)	4.37±1.98	
Type of mother's job	Non	2391 (90.57)	4.68±1.97	<0.001*
	Part-time	81 (3.07)	4.21±2.01	
	Full-time	168 (6.36)	4.02±2.12	
Ethnicity	Fars	1912 (72.42)	4.58±1.99	<0.001*
	Turk	193 (7.31)	5.18±1.61	
	Lors	461 (17.46)	4.59±2.17	
	Other	74 (2.80)	4.56±2.02	
Socio-economic status	High	50 (1.89)	4.21±2.23	0.64*
	Medium-high	302 (11.44)	4.62±2.01	
	Medium	1689 (63.98)	4.64±1.97	
	Medium-low	411 (15.57)	4.60±2.00	
	Low	188 (7.12)	4.67±1.95	
History of the type of deliveries	NVD[a]	1024 (38.79)	4.91±1.80	<0.001*
	Cesarean section	1337 (50.64)	4.45±2.08	
	Both	279 (10.57)	4.45±2.05	
Number of total children born by cesarean sections	Non	1024 (38.79)	4.91±1.80	<0.001*
	One	1165 (44.13)	4.39±2.11	
	Two	359 (13.60)	4.66±1.91	
	Three or more	92 (3.48)	4.44±2.23	
Number of total children born by NVDs[a]	Non	1337 (50.64)	4.45±2.08	<0.001*
	One	671 (25.42)	4.74±1.90	
	Two	417 (15.80)	4.92±1.74	
	Three or more	215 (8.14)	4.84±1.98	
History of abortion/still birth	No	2166 (82.05)	4.69±1.95	0.001**
	Yes	474 (17.95)	4.35±2.11	
History of infertility (primary/secondary)	No	2614 (99.05)	4.63±1.99	0.99**
	Yes	26 (0.98)	4.64±1.49	
History of abnormal child	No	2615 (99.05)	4.63±1.99	0.90**
	Yes	25 (0.95)	1.58±1.50	

[a]normal vaginal delivery; *ANOVA; **Independent t-test

perception regarding insufficiency of their breast milk (P<0.001), undesirable weight gain of infant during EBF (P<0.001), and use of medication by the mother (P<0.001). Other data regarding breastfeeding and infant's nutrition are listed in Table 3.

Results of multivariable analysis, using Adaptive Lasso regression, are presented in Table 4. The 5-fold cross-validation technique estimated the amounts of penalty equal to 0.001. Our proposed model only estimated non-zero coefficients for 17 out of 60 factors assessed. Non-zero factors included in the Lasso model were weight gain during EBF,

Table 2: Comparison of the duration of exclusive breastfeeding based on obstetric history in the current delivery and the newborn status

Characteristic	Sub group	N (%)	Duration of exclusive breastfeeding, (month) Mean±SD	P value
Birth Place	Hospital	2433 (92.16)	4.59±2.00	<0.001*
	Maternity facility	207 (7.84)	5.09±1.76	
Singleton/ multiple pregnancy	Singleton pregnancy	2613 (99.98)	4.66±1.96	<0.001*
	Twin/triple pregnancy	27 (1.02)	1.63±1.71	
Type of delivery	NVD[a]	1038 (39.32)	4.90±1.81	<0.001*
	Cesarean section	1602 (60.68)	4.46±2.08	
Type of Cesarean Section	Non (NVD[a])	1038 (39.32)	4.89±1.81	<0.001**
	Emergency	574 (21.74)	4.56±2.04	
	Planned	1028 (38.94)	4.39±2.09	
Anesthesia type	Non (NVD[a])	1038 (39.32)	4.90±1.81	<0.001**
	General	1047 (39.66)	4.45±2.07	
	Lumbar	555 (21.02)	4.47±2.09	
Child's sex	Girl	1325 (50.19)	4.66±1.94	0.47*
	Boy	1315 (49.81)	4.6±2.03	
infant's irritability in the neonatal period (According to mothers' claim)	Calm	2530 (95.83)	4.65±1.97	0.007**
	Normal crying	90 (3.41)	3.99±2.20	
	Irritable	20 (0.76)	4.98±2.12	
Skin color of infant at birth (According to mothers' claim)	Normal	2214 (83.86)	4.63±1.98	0.23**
	Red	381 (14.43)	4.67±1.95	
	Cyanotic	45 (1.70)	4.13±2.27	
Movement of infant (According to mothers' claim)	Good	2590 (98.11)	4.65±1.97	0.009*
	Weak	50 (1.89)	3.67±2.39	
Place of care after birth	Beside mother	2440 (92.42)	4.65±1.96	0.002**
	Neonate ward	92 (3.48)	4.73±1.99	
	NICU[b]	108 (4.09)	3.98±2.42	
Respiratory status of infant (According to mothers' claim)	Normal	2554 (96.74)	4.63±1.98	0.65**
	Requiring nasal O_2	73 (2.77)	4.42±2.06	
	Requiring intubation	13 (0.49)	4.54±2.17	
Congenital anomaly of infant	No	2594 (98.26)	4.63±1.98	0.96*
	Yes	46 (1.74)	4.64±2.11	
Neonatal's jaundice (Diagnosis by a physician)	No	1707 (64.66)	4.68±1.94	0.054*
	Yes	933 (35.34)	4.53±2.06	
Convulsion of newborn (diagnosed by a physician)	No	2611 (98.91)	4.63±1.98	0.94*
	Yes	29 (1.09)	4.60±2.29	
Infection of the newborn (diagnosed by a physician)	No	2519 (95.42)	4.63±1.98	0.76*
	Yes	121 (4.58)	4.57±2.07	
Maternal Postpartum vaginal bleeding (diagnosed by a physician)	No	2580 (97.73)	4.62±1.98	0.44*
	Yes	60 (2.27)	4.82±2.03	
Maternal infection (resulting in hospitalization or antibiotic treatment)	No	2478 (93.86)	4.66±1.97	0.001*
	Yes	162 (6.14)	4.11±2.16	
Urinary tract infection (diagnosed by a physician)	No	2570 (97.35)	4.63±1.98	0.93*
	Yes	70 (2.65)	4.65±2.11	
Intolerable Pain (needing extra analgesic)	No	2432 (92.12)	4.62±1.98	0.59*
	Yes	208 (7.88)	4.70±2.04	
Depression (resulting in hospitalization or treatment)	No	2544 (96.36)	4.64±1.97	0.07*
	Yes	96 (3.64)	4.19±2.35	

Uterine rupture (diagnosed by a physician)	No	2595 (98.30)	4.63±1.98	0.34*
	Yes	45 (1.70)	4.30±2.31	

[a]normal vaginal delivery; [b]Neonatal Intensive Care Unit; *Independent t-test; **ANOVA when durations of EBF were compared among more than two groups

Table 3: Comparison of the duration of exclusive breastfeeding based on the newborns breastfeeding history

Characteristics	Subgroups	N (%)	Duration of exclusive breastfeeding, (month) Mean±SD	P value
Time of starting breastfeeding	At delivery room	1267 (47.99)	4.66±1.97	<0.001*
	After delivery	1245 (47.16)	4.67±1.93	
	After few days	128 (4.85)	3.91±2.45	
Prior experience with breastfeeding	No	1495 (56.63)	4.54±2.04	0.008**
	Yes	1145 (43.37)	4.75±1.91	
Duration of maternity leave	Housekeeper	2509 (95.04)	4.68±1.97	0.001*
	1 or 2 month(s)	6 (0.23)	2.33±2.84	
	3-6 months	114 (4.32)	4.11±2.11	
	>6 months	11 (0.42)	4.14±1.82	
Mother was trained for breastfeeding	No	564 (21.36)	4.45±2.13	0.02**
	Yes	2076 (78.64)	4.68±1.94	
Number of information resources for correct breastfeeding method (According to mothers' claim)	0	417 (15.80)	4.62±2.01	0.76*
	1	831 (31.48)	4.67±1.99	
	2	699 (26.48)	4.56±1.99	
	>2	693 (26.25)	4.65±1.95	
Using pacifier	No	2009 (76.10)	4.81±1.88	<0.001**
	Yes	631 (23.90)	4.06±2.18	
Giving water to the infant in the first 6 months	No	1711 (64.81)	4.78±1.92	<0.001**
	Yes	929 (35.19)	4.35±2.06	
Giving multivitamin to the infant in the first 6 months	No	577 (21.86)	4.52±2.07	0.16**
	Yes	2063 (78.14)	4.66±1.96	
Estimation of breast milk quantity	Insufficient	674 (25.53)	2.83±2.24	<0.001*
	Medium	165 (6.25)	4.59±1.97	
	Sufficient	1801 (68.22)	5.31±1.37	
Infant's weight gain during EBF[a]	Undesirable	1852 (70.15)	2.98±2.27	<0.001**
	Desirable	788 (29.85)	5.33±1.33	
Number of information resource(s) about advantages of breast milk for a baby (According to mothers' claim)	0	238 (9.02)	4.59±1.99	0.60*
	1	478 (18.11)	4.63±1.98	
	2	807 (30.57)	4.70±1.98	
	>2	1117 (42.31)	4.58±1.99	
Has mother's medication caused termination of breastfeeding	No	2529 (95.80)	4.68±1.95	<0.001**
	Yes	111 (4.20)	3.33±2.28	
History of maternal smoking during lactation	No	2497 (94.58)	4.62±1.99	0.33**
	Yes	143 (5.42)	4.78±1.87	
Congenital malformation	No	2310 (87.50)	4.65±1.98	0.12**
	Yes	330 (12.50)	4.47±2.03	
Current diseases in the infant				
Atopic dermatitis	No	2531 (95.87)	4.63±1.99	0.86**
	Yes	109 (4.13)	4.66±1.87	
Respiratory problems (e.g. hyper-reactive airway)	No	2603 (98.60)	4.64±1.98	0.09**
	Yes	37 (1.40)	3.96±2.38	
Other diseases	No	2584 (97.88)	4.64±1.98	0.02**
	Yes	56 (2.12)	4.00±2.20	

[a]Exclusive Breastfeeding; *ANOVA; **Independent T

Table 4: The effect of non-zero factors on exclusive breastfeeding in adaptive Lasso regression model

Characteristic		Coefficients	SE
Duration of staying at home	housekeeper	---	---
	1 or 2 month	-1.43	0.89
	3-6 month	0.00	0.17
	>6	0.00	0.28
Proper weight gain during EBF[a]	No	---	----
	Yes	1.29	0.21
Singleton/multiple pregnancies	Singleton pregnancy	---	---
	Twin pregnancy	-1.12	0.05
Breast milk sufficiency (According to mothers' claim)	Insufficient	---	---
	Medium	0.62	0.28
	Sufficient	1.08	0.23
Maternal post-partum infection	No	---	---
	Yes	-0.40	0.18
Infant's irritability (According to mothers' claim)	Calm	---	---
	Normal crying	-0.40	0.24
	Irritable	0.00	---
Birth place	Grand hospitals	---	---
	Maternity hospitals	0.36	0.12
Using pacifier	No	---	---
	Yes	-0.35	0.09
Type of mother's occupation	Non (housekeeper)	---	---
	Part-time job	0.00	0.19
	Full-time job	-0.31	0.28
Has mother's medication caused termination of breastfeeding	No	---	---
	Yes	-0.27	0.22
Mode of delivery	NVD[b]	---	---
	Emergency cesarean section	0.00	0.19
	Planned cesarean section	-0.21	0.10
Giving water to the infant in the first 6 months	No	---	---
	Yes	-0.18	0.09
Giving multi-vitamin to the infant in the first 6 months	No	---	---
	Yes	0.09	0.10
Number of total deliveries		0.09	0.07
Number of total cesarean section(s)	Non	---	---
	One	-0.08	0.09
	Two	0.00	0.05
	Three or more	0.00	0.12
Initiation of breast feeding	At delivery room	---	---
	After delivery	0.06	0.07
	After few days	0.00	0.15
Ethnicity	Fars	---	---
	Turk	0.06	0.10
	Lors	0.00	0.08
	Other	0.00	0.10
History of maternal smoking during lactation	No	---	---
	yes	-0.06	0.10
Sex of the child	Girl	---	---
	Boy	-0.05	0.07
Mother's age		-0.02	0.01

[a]Exclusive Breastfeeding; [b]Normal vaginal delivery

singleton/multiple pregnancies, sufficient breast milk, maternal post partum infection, using a pacifier, infant's irritability in the neonatal period, birth place and having a full-time job as the most important factors affecting the duration of EBF (Table 3). Babies with acceptable weight gain during the first 6 months of their life were breastfed for 39 days longer than babies who did not. Also, mothers with at least one or two months of maternity leave breastfed their infants 43 days less than those who either did not work outside their home or took more prolonged time before returning to work. Furthermore, mothers who considered having sufficient breast milk fed their babies 1.08 months longer than those who did not. In order to obtain the standard error of coefficients, a bootstrap method was implemented 500 times. Moreover, adaptive Lasso confirmed that having twin babies, maternal infection, cesarean section due to mother's desire, use of pacifier, and irritability in the neonatal period were associated with lesser duration of EBF (Table 4).

Discussion

In this study, we identified various factors to have a significant association with the duration of EBF. Maternal factors which negatively affected the duration of EBF were mother's post-partum infection, being employed, shorter duration of maternity leave, perceived breast milk insufficiency, positive history of smoking during pregnancy, using medications, and higher maternal age. The factors that significantly enhanced the duration of EBF included singleton pregnancy, delivery place (maternity hospital), NVD as the mode of delivery, babies' proper weight gain during EBF, female gender of neonates, and infants' tranquility. In addition, the time of starting breastfeeding, and using a pacifier, and water, and/ or multi-vitamin in the first 6 months of infants' life were also associated with duration of EBF.

Most of our findings support those of previous studies. We found that mothers undergoing cesarean section had shorter duration of EBF, consistent with results of other studies.[15, 16] This might be attributable to the circumstances to which the mothers who undergo cesarean section are faced in the first hours after delivery, and the fact that early initiation of breastfeeding is an essential factor in breastfeeding success.[24] On the contrary, women who give birth to their baby through NVD are more alert and readier to start breastfeeding in the first hours after delivery than those mothers who had experienced an operation and anesthesia. However, a cross-sectional study conducted in Ethiopia found that EBF was more prevalent in mothers who had given birth to their infants through cesarean section.[14] This could be the result of educational programs provided for mothers whose delivery was performed in hospitals.

Administration of water significantly affected the duration of EBF in the present study; similarly, other researchers have proven that any supplementation, such as sugary water, causes breastfeeding problems.[25] As recommended by the global strategy, EBF means giving nothing other than breast milk and vitamin supplements to the infant during the first six months.[26] Therefore, giving water to the newborn would negatively affect EBF. Also, using pacifiers was introduced as a significant factor interfering with EBF in the present study; similarly, other studies reported that using a pacifier negatively affected EBF.[18, 27] The reason could be the fact that infants satisfy their sucking need with the pacifier which is added to the other disadvantages of the pacifier.[28] However, it was shown that pacifier could help in increasing EBF rate in infants whose mothers were at risk of postpartum depression.[20] In addition, we came to this point that mother's perception of breast milk adequacy was a determinant factor on EBF duration, which has previously been reported by other studies.[16, 27, 29] This finding indicates the need for training mothers appropriately about details of breastfeeding.

We found that mothers' employment, duration of maternity leave had a great impact on the duration of EBF. Our findings are

supported by other studies which revealed that mother's occupation was negatively associated with EBF duration; thus, they may be busy with work and spend less time at home.[30, 31]

Ethnicity of mothers also had a significant association with duration of EBF in the present study, which was confirmed by other Iranian studies.[31, 32] These factors might also be related to the traditions of each ethnicity and the religious recommendations of Islam regarding complete breastfeeding for two years.[33]

Our study had some limitations. We could not access all interviewees who participated in the first phase of the study; they either did not accept or they had not written health events in details. Also, we had to trust the mothers' claim regarding breast feeding information as we had no further sources for double checking. On the other hand, this is one of the unique studies as we considered determinants of EBF in a cohort study with a large sample size from the fifth highly populated province of Iran. Consequently, this community-based study did not limit the data to mothers referring to a specific center that increased the reliability of the results. The other important strength of the present study was considering more than sixty factors and performing Adaptive Lasso regressions that enabled the researchers to assess the factors that are significantly associated with duration of EBF.

Conclusion

In conclusion, various factors play a main role in the duration of EBF, most important of which include twin pregnancies, mother's perception of insufficient breast milk, short maternity leave, using a pacifier for the infant, infant's irritability, birth place and having full-time job. Accordingly, it is suggested that health policy-makers provide more supportive programs for those mothers who have a full time job. Also, more comprehensive educational programs should be designed, in which mothers are informed regarding indicators of insufficiency of breast milk, and the barriers of exclusive breastfeeding including pacifier and sugary water. On the other hand, the observational nature of the study also prevented us from including any intervention in the present investigation. It is, thus, suggested that future prospective interventional studies assess the effect of the modifiable variables, which were found effective in the present study to assess whether these interventions may alter the rate and duration of EBF.

Acknowledgment

This article is extracted from Amirhosein Pourhaghighi's thesis (No. 88/1002). We would like to thank Dr. Carlos Lifschitz for assistance with the final manuscript. Also, we would like to express our gratitude to Vice Chancelor for Research of Shiraz University of Medical Sciences for financially supporting the project.

Conflict of Interest: None declared.

References

1 Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. The Cochrane Database of Systematic Reviews. 2012;8:Cd003517.
2 Flohr C, Henderson AJ, Kramer MS, et al. Effect of an Intervention to Promote Breastfeeding on Asthma, Lung Function, and Atopic Eczema at Age 16 Years: Follow-up of the PROBIT Randomized Trial. JAMA Pediatr. 2018;172:e174064.
3 Smith ER, Hurt L, Chowdhury R, et al. Delayed breastfeeding initiation and infant survival: A systematic review and meta-analysis. PloS One. 2017;12:e0180722.
4 Ehlayel MS, Bener A. Duration of breast-feeding and the risk of childhood allergic diseases in a developing country. Allergy and Asthma Proceedings. 2008;29:386-91.
5 Bell S, Yew SSY, Devenish G, et al. Duration of Breastfeeding, but Not Timing of Solid Food, Reduces the Risk of Overweight and Obesity in Children

Aged 24 to 36 Months: Findings from an Australian Cohort Study. International Journal of Environmental Research and Public Health. 2018;15(4).
6 Turck D, Vidailhet M, Bocquet A, et al. Breastfeeding: health benefits for child and mother. Arch Pediatr. 2013;20:S29-48.
7 Gouveri E, Papanas N, Hatzitolios AI, Maltezos E. Breastfeeding and diabetes. Current Diabetes Reviews. 2011;7:135-42.
8 Unar-Munguia M, Torres-Mejia G, Colchero MA, Gonzalez de Cosio T. Breastfeeding Mode and Risk of Breast Cancer: A Dose-Response Meta-Analysis. Journal of Human Lactation. 2017;33:422-34.
9 Danforth KN, Tworoger SS, Hecht JL, et al. Breastfeeding and risk of ovarian cancer in two prospective cohorts. Cancer Causes & Control. 2007;18:517-23.
10 Pokhrel S, Quigley MA, Fox-Rushby J, et al. Potential economic impacts from improving breastfeeding rates in the UK. Archives of Disease in Childhood. 2015;100:334-40.
11 Haroon S, Das JK, Salam RA, et al. Breastfeeding promotion interventions and breastfeeding practices: a systematic review. BMC Public Health. 2013;13:S20.
12 Conde-Agudelo A, Diaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. The Cochrane Database of systematic Reviews. 2016;(8):Cd002771.
13 Renfrew MJ, Craig D, Dyson L, et al. Breastfeeding promotion for infants in neonatal units: a systematic review and economic analysis. Health Technology Assessment. 2009;13:1-146.
14 Hunegnaw MT, Gezie LD, Teferra AS. Exclusive breastfeeding and associated factors among mothers in Gozamin district, northwest Ethiopia: a community based cross-sectional study. International Breastfeeding Journal. 2017;12:30.
15 Adugna B, Tadele H, Reta F, Berhan Y. Determinants of exclusive breastfeeding in infants less than six months of age in Hawassa, an urban setting, Ethiopia. International Breastfeeding Journal. 2017;12:45.
16 Kasahun AW, Wako WG, Gebere MW, Neima GH. Predictors of exclusive breastfeeding duration among 6-12 month aged children in gurage zone, South Ethiopia: a survival analysis. International Breastfeeding Journal. 2016;12:20.
17 Ogbo FA, Eastwood J, Page A, et al. Prevalence and determinants of cessation of exclusive breastfeeding in the early postnatal period in Sydney, Australia. International Breastfeeding Journal. 2016;12:16.
18 Buccini Gdos S, Perez-Escamilla R, Venancio SI. Pacifier Use and Exclusive Breastfeeding in Brazil. Journal of Human Lactation. 2016;32:Np52-60.
19 Dalili H, Farsar A, Barakati H, et al. Frequency of exclusive breastfeeding and its affecting factors in Tehran, 2011. Acta Medica Iranica. 2014;52:552-6.
20 Sipsma HL, Kornfeind K, Kair LR. Pacifiers and Exclusive Breastfeeding: Does Risk for Postpartum Depression Modify the Association? Journal of Human Lactation. 2017;33:692-700.
21 Thulier D, Mercer J. Variables associated with breastfeeding duration. Journal of Obstetric, Gynecologic, and Neonatal Nursing. 2009;38:259-68.
22 Alzaheb RA. A Review of the Factors Associated With the Timely Initiation of Breastfeeding and Exclusive Breastfeeding in the Middle East. Clinical Medicine Insights Pediatrics. 2017;11:1179556517748912.
23 Maharlouei N, Rezaianzadeh A, Hesami E, et al. The preference of Iranian women to have normal vaginal or cesarean deliveries. Journal of Research in Medical Sciences. 2013;18:943-50.
24 Vieira TO, Vieira GO, Giugliani ERJ, et al. Determinants of breastfeeding initiation within the first hour of life in a Brazilian population: cross-sectional study. BMC Public Health. 2010;10:760.

25 Boskabadi H, Bagheri S. Comparison between infants receiving traditional supplements (camel thorn, flix weed, and sugar water) and exclusively breast fed infants. Avicenna Journal of Phytomedicine. 2015;5:479-84.
26 WHO, UNICEF. Global strategy for infant and young child feeding. Geneva (Switzerland): World Health Organization; 2003.
27 Olang B, Heidarzadeh A, Strandvik B, Yngve A. Reasons given by mothers for discontinuing breastfeeding in Iran. International Breastfeeding Journal. 2012;7:7.
28 Sexton S, Natale R. Risks and benefits of pacifiers. American Family Physician. 2009;79:681-5.
29 Haku M. Breastfeeding: factors associated with the continuation of breastfeeding, the current situation in Japan, and recommendations for further research. The Journal of Medical Investigation. 2007;54:224-34.
30 Khoury AJ, Moazzem SW, Jarjoura CM, et al. Breast-feeding initiation in low-income women: Role of attitudes, support, and perceived control. Womens Health Issues. 2005;15:64-72.
31 Rakhshani F, Mohammadi M. Continuation of breastfeeding: is this a problem in Southeast Iran? Breastfeeding Medicine. 2009;4:97-100.
32 Veghari G, Mansourian A, Abdollahi A. Breastfeeding status and some related factors in northern iran. Oman Medical Journal. 2011;26:342-8.
33 Shaikh U, Ahmed O. Islam and infant feeding. Breastfeeding Medicine. 2006;1:164-7.