

**Title: Description of an mHealth tool for breastfeeding support: LactApp. Analysis of how lactating mothers seek support at critical breastfeeding points and according to their infant's age**

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## **Abstract**

Interventions in mHealth have had positive effects on establishing and maintaining breastfeeding, but we still do not know what content women consult when downloading a mobile breastfeeding application. We conducted an observational, descriptive and retrospective study using the data recorded by LactApp in 2019. The most frequently consulted topics were those related to breastfeeding technique, infant sleep, human milk management and storage, breastfeeding myths, breastfeeding stages, complementary feeding, infant care or returning to work. Our study results also suggest that LactApp's support seems to develop with mothers' needs according to their infant's development stage. The first breastfeeding days include more physiological answers. Between 15 days and 3 months, mothers look for support in topics like breastfeeding crisis/complications and returning to work. At 3 months to 1 year, answers are related to complementary feeding and weaning. When the user's infant is 1 year of age, mothers seek support for weaning, weaning management and tandem breastfeeding.

Keywords: mHealth, breastfeeding support, breastfeeding crisis, breastfeeding application.

## **1. Background**

We face new challenges in health care today. Technology and health applications are increasingly developing to improve user care. Of these improvements, Electronic Healthcare (eHealth) is expected to improve the quality and safety of medical care, as well as healthcare costs (Roberts, Philip, Currie, & Mort, 2015). Using eHealth services helps to support selfcare, enable health service use, and make care and health professionals more accessible (Lindberg, Nilsson, Zotterman, Söderberg, & Skär, 2013).

The use of smartphones for behavioral changes and to adapt to new habits has been demonstrated (Scott & Mars, 2020). There are countless mobile applications that aim to influence the population's health (mHealth). These applications are designed to address different issues, such as blood pressure monitoring (Wang, Zhou, Rezaei, Liu, & Huang, 2019), stress management (Hwang & Jo, 2019), smoking cessation counseling (Heffner et al., 2019) or weight management (Cueto, Wang, & Sanders, 2019). For maternal and neonatal care, there are also applications (Sondaal et al., 2016), focusing on child care, pregnancy and before pregnancy (Zhang, Dong, Chen, Chai, & Liu, 2018). The specific care these applications focus on is aimed at reducing weight gain during pregnancy, increasing fruit and vegetable intake, cessation of smoking or preventing infection (Bush, Barlow, Echols, Wilkerson, & Bellevin, 2017; Overdijkink et al., 2018). They all seem to bring positive results (Bush et al., 2017; DeNicola et al., 2020; Hussain, Smith, & Yee, 2020).

The World Health Organization (WHO) recommends exclusive breastfeeding (BF) for the first 6 months, followed by supplementation with other foods up to the age of 2 years or beyond (Kim, Park, Oh, Kim, & Ahn, 2018), but these recommendations are poorly implemented. Some data suggest that only 40% of infants aged under 6 months are exclusively breastfed worldwide (World Health Organization, 2017), for this reason the WHO proposed a global objective of 50% exclusive breastfeeding in the first 6 months of infant's life (World Health Organization, 2014). Some studies show that the percentages for exclusive breastfeeding in Spain are 16.8% at 6 months (Cabedo et al., 2019). Interventions in mHealth have shown positive efficacy in also establishing and maintaining BF (Uscher-Pines et al., 2019; White, Giglia, Scott, & Burns, 2018), with a significant increase in the marketing of mobile applications related to BF since 2016 (Díaz Cano, Margaix Fontestad, & Esplugues, 2019). Perhaps one of the strengths of the information provided by mHealth is the personalization and interaction of the information, a point highlighted by women (Halili et al., 2018). However, we are still unaware of what content women actually consult when downloading a mobile BF application. Knowing what content a lactating mother is looking for can help health professionals reinforce specific BF content, and enable to carry out

certain Health Education interventions that address pre- and post-natal women. Thus this study aimed to analyze what content women seek in a BF application.

## **2. Methods**

### **2.1. LactApp: an mHealth for breastfeeding**

LactApp started to operate in Spain in 2014 as a Facebook page that collected mother's consultations about breastfeeding. This information was classified on an Excel file and that became the core structure of decision trees found in the application (app). LactApp launched its first version of the app in October 2015. Since then, it has been growing in content and improving its navigation over time. This app was founded by two female Co-founders.

LactApp is a free mobile app designed for BF support. This app is accessible 24 h a day with Internet connection, and offers personalized support. LactApp works as a self-administered questionnaire based on 48 decision trees that include topics about BF, maternity and maternal-infant health and was built with questions and answers written by an IBCLC (International Board-Certified Lactation Consultant). It is supported by scientific evidence and up-to-date official health guidelines, such as the Spanish Ministry of Health (Ministerio de Sanidad Servicios Sociales e Igualdad, 2017) or the protocols of the Academy of Breastfeeding Medicine (Eglash & Simon, 2017). The result of the questionnaire provides over 2,373 personalized answers reached through more than 76,232 possible paths across the decisions trees, which vary according to the user's and her infant's profiles. To reach a final answer, the user must register in the app, and provide his or her e-mail address or sign in using Facebook or Apple sign in.

LactApp's main functionality is its automated BF consultation system. However, it also provides functionalities of BF monitoring, such as child growing trackers, child's bowel movements and BF trackers, where users can record the number of daily BF sessions, their duration and BF-

Other features that LactApp offers are BF tests and personalized plans. The tests are five questionnaires that allow a quick answer about specific situations that arise during BF (The first 5 days of your infant; Getting through the first month; Does my infant breastfeed well?; Is my

infant ready to eat solids?; Do you know if your infant has a tongue-tie?). Personalized plans involve questionnaires that use a logic of proposals with several variables to provide users with proposals and recommendations according to their needs.

BF questions can be consulted through a live chat function answered by IBCLCs, midwives, nutritionists and pediatricians of the LactApp team. Moreover, the flow of queries and interactions through chat collects data for artificial intelligence (AI) and machine learning. LactApp's AI is currently being developed and trained to autonomously reply to consultations.

LactApp is available in English and Spanish. This app can be downloaded on the Android and iOS' systems.

## **2.2. Study design**

We conducted an observational, descriptive and retrospective study using the data recorded by LactApp in 2019 (01/01/2019-31/12/2019), which includes 2,725,925 queries classified as 48 topics (including tests) among 130,000 active users.

## **2.3. Data Collection**

LactApp has an SQL-based database that collects data from registered users, such as e-mail, age, home city, user status (pregnant or not pregnant), due date and number of infants. LactApp also collects data about the registered child to access the answer of a query, such as infant's birth date, gender, whether he or she was premature or not and gestation week, weight and height at birth.

LactApp's database also registers user's query history by registering all final answers of the questionnaires that a user reached, along with date and time of the query, the user identifier, the operating system of the mobile phone used and the language used. All these data from 2019 were extracted and merged with the users and their child data using SQL to create a suitable dataset to perform data analysis.

Google Analytics and Firebase were selected to collect data about the app's usability, and the data from those platforms were anonymized and aggregated (Clark, Nicholas, & Jamali, 2014). The

following variables were collected with these platforms: number of active users, number of sessions and screens, duration of session, languages accessed, countries accessed from, operating system. We were also able to monitor the performance of events: number of queries and test visits. Unique events are defined by Google Analytics as interactions with content by a single user within a single session (Google, 2019). Data extraction was performed monthly between January 1st, 2019 and December 31st, 2019.

## **2.4. Data analysis**

All raw data management and statistical analyses were performed by the R v 3.6.2 in R studio environment (v. 1.2.5001). The data of all final answers reached by users were aggregated weekly, monthly and yearly, and as categories of the topic. Data were also aggregated by the infant's age at the time of the query because it was the main variable that we intended to study.

All the variables were not normally distributed (Shapiro-Wilk test  $p < 0.05$ ), thus non parametric Kruskal-Wallis statistical tests with Dunn *post hoc* were performed to assess the significant differences in the visits of the queries aggregated as topics according to the user's infant age. P-values were corrected by the number of users in each group category and adjusted by the False Discovery Rate (FDR). A Principal Component Analysis (PCA) was also carried out to plot the difference in uses of queries according to the user's infant age.

## **2.5. Ethical considerations**

This study followed Spanish Organic Law 3/2018, of December 5, on Personal Data Protection and Guaranteeing Digital Rights. Registration in LactApp requires users accepting Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with regard to the Processing of Personal Data and on the Free Movement of Such Data (General Data Protection Regulation).

## **3. Results**

### **3.1. User profile and app activity**

LactApp had 130,000 active users in 2019. Active users were those who accessed the app during the last estimated time period, employed to measure the app's relevance. Daily, weekly and monthly users were normally evaluated. In 2019, LactApp had an average of 2,400 active users a day, 10,000 a week and 28,000 a month.

In 2019, LactApp received 2,725,925 queries, which represents an average of 52,421 weekly queries, and 78,087 users accessed LactApp to answer questions about BF, which accounted for a mean of 32.8 queries per user and a mean 6-minute duration with 18 seconds per session.

According to Google Analytics and Firebase databases, 90% of active users were female aged between 25 and 34 years (58%). The main regions from which users accessed the app were Spain (79.4%), Mexico (4.5%), Chile (2.8%), Colombia (1.8%) and the United States (1.1%).

Table 1 provides socio-demographic data of registered users and their infant in 2019. LactApp registered 71,807 new users in its database, but only 1,559 (2.17%) of them optionally recorded their personal data. Of registered users in LactApp in 2019, 94% (n=1,471) were pregnant and most (68%, n=1,063) were primiparous.

During the same period, 44,342 infants were registered, of whom 50.7% (n=22,511) were male with an average age of 3.4 months ( $\pm 6.4$  months), a mean birth weight of 3210.8 g ( $\pm 492.8$  g) and a birth height of 49.6 cm ( $\pm 2.48$  cm). Finally, 6.12% (n=2,715) of registered infants were premature at a mean gestation week of 33.7 weeks ( $\pm 4.2$  weeks).

## **3.2. LactApp's usability**

### **3.2.1. Most frequent queries**

Table 2 and Appendix 1 offers the annual frequency of the responses aggregated as topics.

The 10 most frequently consulted topics in 2019 were those related to BF technique, infant sleep, human milk management and storage, BF myths, BF stages, complementary feeding, infant care, BF products, mixed feeding and returning to work. These queries represented 59.6% (n=1,625,591) of all the total queries made, which could represent the critical BF point.

### **3.2.2. Using LactApp's content according to infant's age**

Table 3 and Appendix 2 offers the mean weekly queries aggregated as topics according to the user's infant's age. As we can see, the queries visited by users changed according to their infant's age, and a pattern of needs appeared depending on the infant's development stage.

The most frequently made queries at lactation onset were related to BF technique, followed by the first days of BF, infant sleep, breast pain and BF products. Between the ages of 15 days and 3 months, the most frequently made queries were related to BF technique, infant sleep, human milk management and storage, BF myths and infant care. In the following age category (3- 6 months), the most consulted responses were related to human milk management and storage, complementary feeding, infant sleep, returning to work and BF myths. In the age group from 6 months to 1 year of age, users consulted queries related to complementary feeding, infant sleep, BF infants over 6 months, human milk management and storage, and BF stages. Once the infant was older than 1 year, users visited responses related to infant sleep, BF stages, breast pain, BF technique, weaning, weaning management and tandem BF.

Some topics were frequently consulted regardless of the infant's age, such as infant sleep and BF technique. However, some were consulted much more often in accordance with the infant's development stage. In order to explore which topics were associated with each age category, a PCA was performed. Figure 1 shows the PCA biplot, which illustrates that the topic "the first days of BF" was associated with the 0-15 days age group, while "returning to work", "weaning", "weaning management", "complementary feeding", "baby-led weaning" and "BF infants over 6 months" were related to the 3-6 months and the 6 months to 1 year age groups. "Tandem BF" was associated with the over 1 year age category. Finally, the 15 days to 3 month age group was the most diverse group in consulting topics, and was associated with various topics like "growth spurts", "breast pain", "breast refusal", "breast shape and size", "pumping milk", and "increased milk demand", among others.

Figure 2 shows the boxplot of the 16 topics that contributed more to construct principal components 1 and 2 which were, thus, the most discriminating variables among the infant age

categories. The weekly visiting frequency of the topics “growth spurts”, “BF myths”, “infant care”, “make more milk pumping”, “how to express milk”, “hypogalactia”, “mixed feeding”, “breast shape and size”, “infant poops”, “BF stages”, “weaning”, “returning to work” and “cracked nipples” significantly increased ( $p<0.05$ ) for the 15 days to 3 months age group compared to the other age groups. “Complementary feeding”, “BF infants over 6 months”, “Baby-Led Weaning”, and “weaning” queries significantly increased ( $p<0.05$ ) for the 3-6 months and the 6 months to 1 year age groups compared to the other age groups. Lastly, “tandem BF”, “weaning”, and “weaning management” queries significantly rose ( $p<0.05$ ) for the over 1 year age group compared to the other age groups.

### **3.2.3. Usage of LactApp’s tests according to infant age**

Visits to LactApp’s tests also changed according to the user’s infant’s age (see Table 4). As the PCA biplot in Figure 3 illustrates, lactation onset was associated with the test “The first 5 days of your infant”, while the most frequently visited test was “Is my infant ready to eat solids?” for the 3-6 months age group. The 15 days to 3 months age group was more heterogeneous and associated with “Do you know if your infant has a tongue-tie?”, “Does my infant breastfed well?”, and “Getting through the first month”.

## **4. Discussion**

e-Technologies and mHealth applications can be a promising tool for BF support and increasing BF rates (Lau, Htun, Tam, & Klainin-Yobas, 2016; Lee et al., 2016). The authors of these studies reported that the main reasons technologies can help establish or maintain breastfeeding are portability, efficiency, reduced mobility limitations, improved confidence, better social support, or a wide range of information (Lau et al., 2016). However, none of these studies has examined how lactating mothers seek support when using an mHealth tool. The present study aimed to analyze which content and answers women look for during BF and according to their infant’s age.



The sustained LactApp user activity, as shown by number of active users and visits, proves that LactApp may be a BF support tool, and not just for its content, but also for its features like tests and trackers, live chat with BF experts and personalized plans. Personalized information and more interaction are characteristics that women demand (Halili et al., 2018). This personalized information is highlighted as essential for BF maintenance by mothers and health professionals (Garner et al., 2016; Robinson, Lauckner, Davis, Hall, & Anderson, 2019). A previous study revealed that LactApp queries increased between July 2016 and June 2019 and the trend of queries has grown according to Prais-Winsten auto-regressions based on the Durbin-Watson model (article under peer review).

Different factors can contribute to shorter BF durations, including mother's perception of insufficient milk supply, nipple or breast pain, lack of social support, lack of confidence, physical and social embarrassment, comfort and trust in formula (Morrison, Gentry, & Anderson, 2019; Schindler-Ruwisch, Roess, Robert, Napolitano, & Chiang, 2018), which are associated with difficulty with latch and position, and the presence of infant tongue-tie, among other factors (Kent et al., 2015). Furthermore, there are critical moments that encourage the abandonment of breastfeeding such as the feeling of lack of milk in periods of high growth of the infant (Vila-Candel, Soriano-Vidal, Murillo-Llorente, Pérez-Bermejo, & Castro-Sánchez, 2019), or the return to work and short maternal leaves (Cabedo et al., 2019; Tsai, 2013; Dinour & Szaro, 2017; Morrison et al., 2019; Navarro-Rosenblatt & Garmendia, 2018). To maintain breastfeeding after returning to work, mothers need to pump and store their milk (Kozhimannil, Jou, Gjerdingen, & McGovern, 2016). This factor causes much concern in mothers (Valizadeh et al., 2017), as reflected by the numerous visits that LactApp receives about how to pump milk correctly and more effectively, and how to store milk appropriately. The most frequently queried topics in 2019 were those related to this critical stages in which mothers need more support, such as BF technique and myths, infant sleep, infant care and behavior, growth spurts, BF stages, mixed feeding, complementary feeding, pumping milk and its storage and returning to work. There are still gaps in how to provide effective support in these situations (Galipeau, Baillot, Trottier, & Lemire,

2018). Thus LactApp's personalized answers could provide lactating mothers support in these situations of high BF abandonment.

The results of this study suggest that LactApp's support seems to develop with mothers' needs according to their infant's developmental stage. The topics that mothers seek differ at lactation onset than when their infant is 1 year old. At BF onset, women consult topics related to the first days of BF, which include the answers of the most frequent concerns, like "should I wake my infant up?", "my infant is not making any bowel movements", "how frequent do infants breastfeed?", "lack of milk supply perception in the first days", "warning signs", or "my infant does not latch on or struggles to latch on". At the beginning of lactation, mothers also make queries about breast pain in relation to sore nipples, mastitis and other common complications. This coincides with the most common reasons for early cessation of breastfeeding according to the literature (Morrison et al., 2019).

When infants are aged between 15 days and 3 months, mothers seek more diverse queries. In this BF stage, mothers look for support in diverse topics that can be further grouped according to BF crisis, returning to work and BF complications. Answers to mothers' queries related to BF crises include "growth spurts", "increased milk demand", "my breast feels empty and soft", "my infant gets frustrated on the breast", "my infant is not gaining weight", or the test "Do you know if your infant has tongue-tie?", "Does my infant breastfeed well?" and "Getting through the first month". In Spain, due to short maternal leaves, at this age mothers start preparing to return to work (Dinour & Szaro, 2017; Morrison et al., 2019; Navarro-Rosenblatt & Garmendia, 2018; Cabedo et al., 2019), and seek more answers about mixed feeding, how to express milk efficiently, and how to manage and store milk.

When infants are aged between 3-6 months and 6 months to 1 year, lactating mothers seek similar answers related mostly to complementary feeding and weaning. The topic of BF infants over 6 months old includes answers like: "my infant has stopped eating solids", "my infant bites my breasts", "my infant feeds too much at night", "weaning my infant at night", "I think my infant is too dependent on my breast", "infant demands breast aggressively", "I feel uncomfortable

breastfeeding in public” or “I’m getting tired of breastfeeding”. Finally, when infants are 1 year old, mothers look for support in weaning, weaning management (Brockway & Venturato, 2016; Yate, 2017) and tandem BF (O’Rourke & Spatz, 2019).

Finally, it is necessary to discuss other findings that have been highlighted. 13% of LactApp users were men, which demonstrates the importance of the father's role in breastfeeding (deMontigny, Gervais, Larivière-Bastien, & St-Arneault, 2018; Rempel, Rempel, & Moore, 2017), the father's influence on the duration of breastfeeding (Rempel et al., 2017), and the increasing involvement of fathers in breastfeeding (deMontigny et al., 2018). Another interesting finding related to socio-demographic data may be the percentage of active users according to age. LactApp has an international vision and the age of maternity can be very varied around the world. While in South America women are young mothers (Yu, Mason, Crum, Cappa, & Hotchkiss, 2016), in Spain the maternity age is increasing (Instituto Nacional de Estadística, 2019).

With all these findings, we believe that LactApp can influence the maintenance of BF, as does social media (Black, McLaughlin, & Giles, 2020) and other applications (Gonzalez-Darias, Diaz-Gomez, Rodriguez-Martin, Hernandez-Perez, & Aguirre-Jaime, 2020); but this should be tested in future studies. In future work we would also like to determine whether there are differences between what mothers’ consult depending on their culture, their socio-demographic data or whether their infants were born prematurely or with low birth weight. Thru this work it can be highly interesting to know what kind of support mothers expect and need during breastfeeding. We believe that, for mothers, LactApp can also be a female empowerment tool that allows women to make informed decisions about BF. On the other hand, given the lack of knowledge of healthcare professionals about BF (Colaceci et al., 2020; Quinn & Tanis, 2020) and the insufficient time in health professionals’ consultations (Gilmour, Strong, Chan, Hanna, & Huntington, 2016), LactApp can be prescribed by healthcare providers, like other tools (Agarwal et al., 2019; Dufour et al., 2019).

The main limitation of our study is that the profile set up of users and their infant is optional and not verified, thus models may involve some uncontrolled bias. Moreover, data from Google

Analytics and Firebase, employed to characterize users, may also include some uncontrolled bias as women might use the smartphone of their husband, partner or other family member to consult LactApp. Another limitation to consider is that some users might browse the application without a specific consultation, while others might consult for a third person by acting as an intermediary between LactApp and the consulting person. We have also detected users who do not make pre-established queries and go directly to the live chat. These considerations may influence the number of visits received.

In conclusion, the most consulted queries in LactApp made by lactating mothers are those related to critical moments in the abandonment of BF. LactApp is a tool that provides lactating women with BF support and information in those critical stages by offering personalized answers. The use of LactApp's content changes depending on the BF stage and users' infant's age. These findings may be of great interest in determining women's empowerment to make informed decisions about BF and about the effectiveness of LactApp in maintaining BF. Finally, LactApp can be a powerful mHealth tool prescribed by healthcare professionals.

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Table 1. Socio-demographic data of LactApp users in 2019

		<b>n</b>	<b>%</b>
<b>Active users in 2019</b>		130,000	
Language	Spanish	116,400	89.5%
	English	8,315	6.4%
Operating system	Android	84,000	64.6%
	iOS	46,000	35.3%
Gender	Female	68,977	87%
	Male	10,341	13%
Age	18-24 y	5,689	4.4%
	25-34 y	51,124	39.3%
	35-44 y	29,378	22.6%
	45-54 y	3,675	2.8%
	55-64 y	1,501	1.1%
	>65 y	441	0.3%
<b>Registered users in 2019</b>		71,807	
Users with registered data		1559	
Status	Pregnant	1471	94
	Not Pregnant	88	6
Number of children	0	1063	68
	1	396	25
	2	83	5
	3	14	1
	≥4	3	0.2
<b>Registered infants in 2019</b>		44342	
Gender	Female	21,831	49.2
	Male	22,511	50.7
Age	0-15d	12,495	28.9
	15d-3m	18,360	42.4
	3m-6m	6,603	15.3
	6m-1y	2,806	6.5
	>1y	2,960	6.8
Birth weight	1000 g	13	0.03
	1000-1500 g	224	0.52
	1500-2000 g	2,977	6.9
	2500-4000 g	37,723	88.2
	>4000 g	1,793	4.19
Birth height	≤48 cm	11,388	27.6
	48-52 cm	25,912	62.9
	>52 cm	3,909	9.48
Premature	Preterm	2,715	6.1
	Full-term	41,627	93.9

Table 2. Annual frequency of the 10 most popular queries according to topics.

<b>Topic</b>	<b>Query frequency</b>	<b>%</b>	<b>Accumulated %</b>
Breastfeeding technique	321265	11.8	11.8
Infant sleep and breastfeeding	253046	9.3	21.1
Human milk management and storage	202948	7.4	28.5
Breastfeeding myths	158675	5.8	34.3
Breastfeeding stages	134507	4.9	39.3
Complementary feeding	130732	4.8	44.1
Infant care	125961	4.6	48.7
Breastfeeding products	113382	4.2	52.8
Mixed feeding	94004	3.4	56.3
Returning to work	91071	3.3	59.6

Table 3. Mean weekly queries aggregated as the most consulted topics according to the user's infant's age

Topic	Infant's age					overall p-value <sup>a</sup>
	0-15 d n=13220	15 d-3 m n=27355	3 m-6 m n=18471	6 m-1 y n=11434	>1 y n=8626	
Infant sleep and breastfeeding	567.1	2406.4	978.3	482.8	265.8	<0.01
Breast pain	459.5	1293.8	301.2	202.2	246.1	<0.01
Breastfeeding myths	351.8	1693.5	553.7	202.3	162.7	<0.01
Breastfeeding products	363.6	1081.9	344.9	85.2	92.9	<0.01
Breastfeeding stages	329.8	1084.4	528.2	294.2	259.7	<0.01
Breastfeeding technique	1762.1	3696.7	531.1	110.7	238.9	<0.01
Complementary feeding	12.6	261	1129.2	1312.9	122.8	<0.01
Human milk management and storage	241.9	1762.4	1247.2	329.4	165.9	<0.01
Returning to work	53.8	614	767.1	183	65.7	<0.01
Tandem breastfeeding	11.2	36.3	35.3	48.7	194.2	<0.01
The first days of breastfeeding	803.5	799	154.5	47.7	127.8	<0.01
Infant care	301.5	1590	305.9	57	107.7	<0.01
Weaning	11.1	134.6	147.3	183.1	200.9	<0.01
Weaning management	7	96.2	147.9	180.4	200.4	<0.01

<sup>a</sup>Non parametric Kruskal-Wallis test, p-values adjusted for the number of users of each age category and corrected by the "False Discovery Rate".

Table 4. Mean weekly tests performed by users according to infant's age

<b>Test</b>	<b>Infant's age</b>					<b>overall p-value<sup>a</sup></b>
	<b>0-15 d</b>	<b>15 d-3 m</b>	<b>3 m-6 m</b>	<b>6 m-1 y</b>	<b>&gt;1 y</b>	
Do you know if your infant has tongue-tie?	6.7	51.5	18.6	5.7	6.5	<0.01
Does my infant breastfeed well?	27	142.2	40.2	4.1	9.6	<0.01
Getting through the first month	9.2	120.1	2.8	0.7	6	<0.01
Is my infant ready to eat solids?	0.3	4.9	69.3	29.2	5	<0.01
The first 5 days of your infant	59.6	30.8	6.7	2.3	9.7	<0.01

<sup>a</sup>Non parametric Kruskal-Wallis test, p-value was corrected by the number of users of each age category

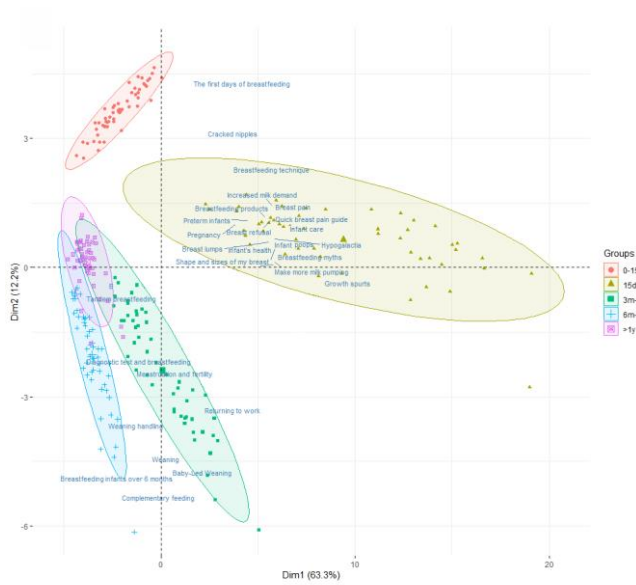


Figure 1. PCA biplot of the weekly queries aggregated as topics according to users' infant's age.

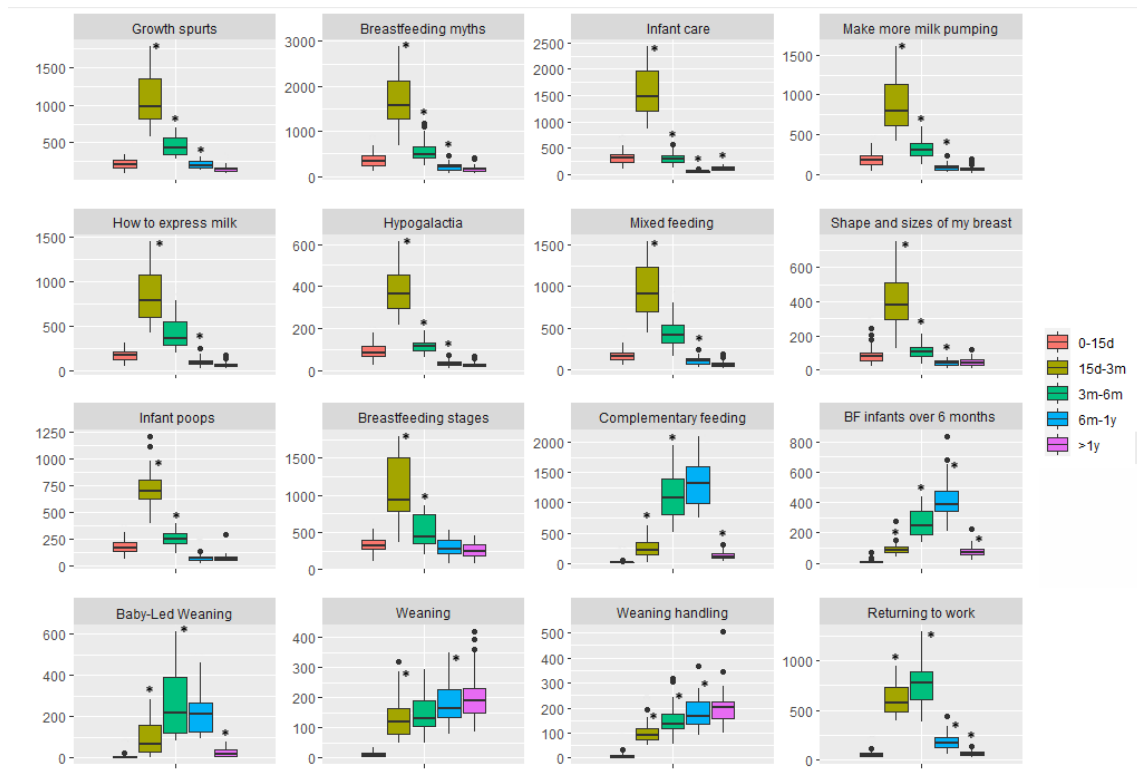


Figure 2. Boxplots of the topics that most contribute to discriminate users' infant age groups.

\*Significant differences compared to the prior infant age group (p-value < 0.05 of Dunn *post hoc* of the Kruskal-Wallis test, p-value corrected by number of users in each group category and adjusted for FDR).





Figure 3. PCA biplot of the weekly queries aggregated as tests according to users' infant's age.

Appendix 1. Annual frequency of queries according to topics (complete)

<b>Topic</b>	<b>Query frequency</b>	<b>%</b>	<b>Accumulated %</b>
Breastfeeding technique	321265	11.8	11.8
Infant sleep and breastfeeding	253046	9.3	21.1
Human milk management and storage	202948	7.4	28.5
Breastfeeding myths	158675	5.8	34.3
Breastfeeding stages	134507	4.9	39.3
Complementary feeding	130732	4.8	44.1
Infant care	125961	4.6	48.7
Breastfeeding products	113382	4.2	52.8
Mixed feeding	94004	3.4	56.3
Returning to work	91071	3.3	59.6
Growth spurts	89482	3.3	62.9
Make more milk pumping	83397	3.1	66
How to express milk	74682	2.7	68.7
Breast pain	67196	2.5	71.2
Infant bowel movements (poo)	55702	2	73.2
The first breastfeeding days	48990	1.8	75
Increased milk demand	47798	1.8	76.8
Sore nipples / nipple damage	40478	1.5	78.3
Shape and size of breasts	38170	1.4	79.7
Breastfeeding infants over 6 months	36696	1.3	81
Weaning	36544	1.3	82.3
Babywearing	35525	1.3	83.7
Hypogalactia	34254	1.3	84.9
Weaning management	33859	1.2	86.1
Pregnancy	31977	1.2	87.3
Breast lumps	28935	1.1	88.4
Breast refusal	27530	1	89.4
Infant's health	27017	1	90.4
Mother's diseases	26133	1	91.3
About the mother's feelings	25219	0.9	92.3
Menstruation and fertility	21317	0.8	93.1
Infant does not gain weight	21111	0.8	93.8
Tandem breastfeeding	19706	0.7	94.5

Relactation	17607	0.6	95.2
Quick breast pain guide	17272	0.6	95.8
Milk donation	13703	0.5	96.3
Test: Does my infant breastfeed well?	11920	0.4	96.8
Mother's disease and breastfeeding	11341	0.4	97.2
Test: Getting through the first month	7404	0.3	98.1
Health situation and breastfeeding	7162	0.3	98.4
Test: The first 5 days of your infant	5944	0.2	98.6
Milk supplementation	5875	0.2	98.8
Test: Is my infant ready to eat solids?	5845	0.2	99.1
Baby-Led Weaning	5461	0.2	99.3
Test: Do you know if your infant has tongue-tie?	4817	0.2	99.4
Breastfeeding twins	3982	0.1	99.6
Preterm infants	3276	0.1	99.7
Clinical diagnostic tests and breastfeeding	3100	0.1	99.8
I want to be a milk donor	2981	0.1	99.9
Induced lactation	2171	0.1	100

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Appendix 2. Mean weekly queries aggregated as topics according to the user's infant's age (complete).

Topic	Infant's age					overall p-value <sup>a</sup>
	0-15 d n=13220	15 d-3 m n=27355	3 m-6 m n=18471	6 m-1 y n=11434	>1 y n=8626	
About the mother's feelings	51.1	253.5	89.5	82.3	33	<0.01
Infant's health	64.8	270	80.7	38.2	40.3	<0.01
Infant does not gain weight	38.8	207.4	104.2	30.9	31.9	<0.01
Baby-Led Weaning	5.1	98.3	257.9	210.2	26.6	<0.01
Infant bowel movements (poo)	171.8	707.8	254.9	68.7	71.2	<0.01
Infant sleep and breastfeeding	567.1	2406.4	978.3	482.8	265.8	<0.01
Babywearing	37.8	337.6	144.9	52.7	46.9	0.13
Breast lumps	138.5	347.1	132	87.9	78.5	<0.01
Breast pain	459.5	1293.8	301.2	202.2	246.1	<0.01
Breast refusal	96.2	318.7	70.9	20.8	30.6	<0.01
Breastfeeding infants over 6 months	9.9	92.3	266	415	79	<0.01
Breastfeeding myths	351.8	1693.5	553.7	202.3	162.7	<0.01
Breastfeeding products	363.6	1081.9	344.9	85.2	92.9	<0.01
Breastfeeding stages	329.8	1084.4	528.2	294.2	259.7	<0.01
Breastfeeding technique	1762.1	3696.7	531.1	110.7	238.9	<0.01
Breastfeeding twins	8.1	35.2	14.2	5.8	6.3	<0.01
Complementary feeding	12.6	261	1129.2	1312.9	122.8	<0.01
Sore nipples / nipple damage	288.6	315.8	65.8	56	78.6	<0.01
Clinical diagnostic tests and breastfeeding	1.7	24.6	18.9	15.6	16.7	<0.01
Growth spurts	216.9	1073.6	455.8	213.7	150.1	<0.01
Human milk management and storage	241.9	1762.4	1247.2	329.4	165.9	<0.01
Health situation and breastfeeding	13.9	95.5	69.2	42.3	44.4	<0.01
How to express milk	171	846.9	406	92.4	61.6	<0.01
Hypogalactia	91.2	376.9	115.9	33.4	26.3	<0.01
I want to be a milk donor	3	19.5	14.6	8.2	7.1	<0.01
Increased milk demand	204.2	841.5	98.9	45.7	83.8	<0.01
Induced lactation	2	15	9.9	6.9	5.4	<0.01
Make more milk pumping	182.1	870.4	320.8	88.1	67.3	<0.01
Menstruation and fertility	6.1	144.6	114.1	72.3	55.5	0.22
Milk donation	13	116.9	67.6	33	27.9	<0.01
Mixed feeding	168.6	974	434.3	106.1	65	<0.01
Mother's disease and breastfeeding	16.4	128.4	78.4	50.6	45.3	<0.01
Mother's diseases	38.2	282.4	151.8	88.5	73.8	<0.01
Pregnancy	37.8	71.8	32.6	20.2	50.2	<0.01
Preterm infants	10.8	32.1	8.9	3.8	4.8	<0.01
Quick guide to breast pain	131.2	401.6	105.7	70.7	84.5	<0.01
Relactation	63.9	349.8	127.2	25.4	23.3	<0.01
Returning to work	53.8	614	767.1	183	65.7	<0.01
Breast shape and size	83.8	401.2	109.9	39.7	43	<0.01
Milk supplementation	30.9	133.9	65.8	13.9	10.2	<0.01
Tandem breastfeeding	11.2	36.3	35.3	48.7	194.2	<0.01

The first days of breastfeeding	803.5	799	154.5	47.7	127.8	<0.01
Infant care	301.5	1590	305.9	57	107.7	<0.01
Weaning	11.1	134.6	147.3	183.1	200.9	<0.01
Weaning management	7	96.2	147.9	180.4	200.4	<0.01

<sup>a</sup>Non parametric Kruskal-Wallis test, p-values adjusted for the number of users of each age category and corrected by the “False Discovery Rate”.